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C	Revised per ECN TRN 7062/DRC #G2980, dated, 9/11/89.	9/12/89	
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L	Revised per ECN TRN 9963.	C/M/TR 11/29/94	11/28/94
M	Revised per ECN TRP 0765. CCR's 1283, 1272, 1285, & 1339.	CM/TR 8/12/95	8/10/95
N	Revised per ECN TRP 1464. CCR's 1203, 1252, 1356A, 1373, 1397, &1401.	CM/AC 7-15-96	7/19/96
P	Revised per ECN TRP 1672/CCR's 1415&1411.	CM/AC 10/22/96	10/29/96
R	Revised per ECN TRP 1985/CCR's1436&1461.	CM/AC 5/8/97	5/2/97
T	Revised per ECN TRP 2124/CCR 1472.	CM/AC 9-30-97	9/29/97

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MISSILES & SPACE OPERATIONS
SUNNYVALE, CA 94088-3504

Revision Record Continued on Sheet . 2

CM M Wang 9/10/98

Contract No. 28000 Mod 04

Written Susan Gregg
Date 3 September 1986

Approved R.M. Cummings
Date September 8, 1986

Approved
Date

J M Cummins 9-15-86
Product Assurance

MARTIN MARIETTA ASTRO SPACE
East Windsor, NJ/Valley Forge, PA

MARTIN MARIETTA

UNIQUE INSTRUMENT INTERFACE SPECIFICATION FOR THE ADVANCED MICROWAVE SOUNDING UNIT-B (AMSU-B)

Size	Code Ident No.	
A	49671	IS 2613442

AE 869 5/70

AMSU-B

REVISIONS		Y	
Ltr	Description	Date	Approved
U	Revised per ECN/TRP2187, CCR 2357	3/23/99	A. Jou 3/23/99
U1	Revise per ECN/TRP2273, CCR 1513,QAB-VD810-0003-01	3/23/99	A. Jou 3/23/99
V	Incorporate ECN/TRP2273 QAB-VL810-0005-01X	3/23/99	A. Jou 3/23/99
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W1	Revise per EJA/ECN TRP2612, CCR 2391, QAB-VD810-0018-01.		
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Size	Code Ident No.	
A	06887	IS 2613442

Sheet 2

TIROS-N

UNIQUE INTERFACE SPECIFICATION

For The

ADVANCED MICROWAVE

SOUNDING UNIT-B (AMSU-B)

Approval:

GE: Interface Engineer

MET Office: Instrument Engineer

GE: Systems Engineer

MET Office: Program Manager

GE: TIROS Program Manager

BAe: Program Manager

NASA: Instrument Technical Officer

NASA: Instrument Manager

NASA: Project Manager

Size	Code Ident No.	
A	49671	IS-2613442
		Sheet 3

A 772 11/85

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LIST OF ILLUSTRATIONS

LIST OF TABLES

1.0 SCOPE

This document establishes the electrical, mechanical and thermal interfaces between the Advanced Microwave Sounding Unit B and the Advanced TIROS-N Spacecraft (ATN) and Spacecraft Aerospace Ground Equipment.

This document, in conjunction with IS-3267415, also details all environments which will be seen by the instrument from the time of its arrival at Lockheed Martin through spacecraft launch, including all phases of storage and test. In addition, specific information about unique instrument properties or requirements in associated areas (such as power and handling requirements, test requirements, test equipment, targets, etc.) is contained herein.

General interface requirements, common to all instruments, are given in the General Instrument Interface Specification (IS-3267415). In the event of conflict between this specification and the General Instrument Interface Specification, this specification shall govern. Where the requirements for a particular interface parameter are omitted from this specification, the General Instrument Interface Specification requirement shall apply.

2.0 APPLICABLE DOCUMENTS

The latest issue of the following document is invoked in entirety. In the event of conflict between this unique specification and the referenced general document, this unique specification shall govern.

IS-3267415 ATN-KLM General Instrument Interface Specification

2.1 Reference Documents

The current issues of the following documents relate to the interface. Some of the documents are for reference only; others are required documents. The required documents are indicated by an asterisk. Changes to these documents which affect form or function of the spacecraft interface will be submitted to the NASA TIROS Project Office for CCR Action.

2.1.1 Lockheed Martin Documents

(1)	3278778	Field of View Drawing*
(2)	3287774	KLM RSS Thermal Finishes*
(3)	3287775	KLM ESM Thermal Finishes*
(4)	3287776	KLM IMP Thermal Finishes*
(5)	20028675	Logic Diagrams
(6)	3278200	ATN Spacecraft Assembly*
(7)	3278776	ATN-KLM ESM Assembly, GFE*
(8)	3267412	Quality Assurance Program for NOAA-KLM
(9)	3267411	Reliability Program Plan for NOAA-KLM
(10)	3278779	ATN Spacecraft Orbital Configuration

2.1.2 Instrument Contractor Originated Documents

(1)	BAe CPL565	Thermal Interface Control Drawing, Issue 002 (8/5/91)*
(2)	STN/AMS/J3773/BAe	Reduced Thermal Model*
(3)	BAe CPL556	Outline/Interface Control Drawing, Issue 002 (8/6/92)*
(4)	-	Schematics (to first active element)
(5)	TVTR/MO/01	Thermal Vacuum Target Requirements and Use
(6)	TDR/MO/01	Test Data Reduction and Correlation Requirements**
(7)	ICP/MO/01	Instrument Calibration Procedure**
(8)	OPM/AMS/J3726/ BAe***	Instrument Safety Requirements** (***Operations Manual)
(9)	OPM/AMS/J3726/ BAe***	Functional Operating Procedure** (***Operations Manual)
(10)	TP/MO/01	Test Procedures** (a) Pre-installation Bench Checkout (b) Spacecraft Ambient and Thermal-Vacuum Targets (c) Bench Checkout Test Equipment.
(11)	TAA/187	Drill Template Drawing*
(12)	SAR/AMS/J3526/BAe	Finite Element Model (12/20/90)*
(13)	LET/AMS/J2168/BAe	Reduced Surface Model (11/02/90)
(14)	HPR/AMS/J1890/BAe, Issue 3	AMSU-B General Handling Procedure**
(15)	PLN/AMS/J2949/BAe	AMUS-B ESD Control Plan

2.1.3 NASA Originated Documents

(1) GSFC-S-480-40 Performance Assurance Requirements for the Advanced Microwave Sounding Unit

(2) GSFC PPL-19, October 1989 (Rev. 1, 3/01/91)

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* Required

**3 months prior to delivery of flight models to Lockheed Martin

3.0 REQUIREMENTS

3.1 Electrical

The electrical interfaces shall comply with the General Instrument Interface Specification (IS-3267415).

3.1.1 Grounds

The instrument shall conform to the grounding requirements of Section 3.1.1 of the General Instrument Interface Specification, IS-3267415.

3.1.1.1 Exceptions

The exceptions to the above specification are as follows:

Signal return is located on the power connector.

3.1.1.2 Other Grounding Requirements

a) There shall be a ground strap
b) Dedicated analog telemetry ground

3.1.2 Connectors

The instrument shall conform to Section 3.1.2 of the General Instrument Interface Specification, IS-3267415.

3.1.2.1 Exceptions

The exceptions to the above specification are as follows:
NONE

3.1.2.2 Connector Allocation

Connector requirements for the instrument shall be as shown in Table 1.

3.1.2.3 Connector Mounting Hardware

Standard Cannon Royal-D Connector

3.1.2.4 Connector Keying Requirements

The connector keying shall be done in a manner which guarantees that it is impossible to improperly connect the instrument cables.

3.1.2.5 Harness Mating Connectors

The mating connector requirements for the spacecraft harness shall be as shown in Table 2.

TABLE 1. AMSU-B INSTRUMENT CONNECTOR REQUIREMENTS

Connector Name Code	Type	Description (Pins, Sex)	Function
J1	DBM-25P-NMB-K56	25 pin male	Power
J2	DEM-9S-NMB-K56	9 pin female	AIP/Digital
J3	DEM-9P-NMB-K56	9 pin male	1.248 MHz Clock
J4	DCM-37P-NMB-K56	37 pin male	Command
J5	DCM-37S-NMB-K56	37 pin female	Digital B Telemetry
J6	DDM-50S-NMB-K56	50 pin female	Analog Telemetry
J7	DDM-50P-NMB-K56	50 pin male	Test (PEU)
J19	DCM-37S-NMB-K56	37 pin female	Test (PSU)
J31	DDM-50S-NMB-K56	50 pin female	Test (Emulator)

TABLE 2. SPACECRAFT HARNESS CONNECTOR REQUIREMENTS

S/C Designation	Part No.	Type	Description (Pins, Sex)	Function
P1	1721489-3	DBM-25S-NMB-K56	25 pin female	Power
P2	1721490-1	DEM-9P-NMB-K56	9 pin male	AIP/Digital
P3	1721489-1	DEM-9S-NMB-K56	9 pin female	1.248 MHz Clock
P4	1721489-4	DCM-37S-NMB-K56	37 pin female	Command
P5	1721490-4	DCM-37P-NMB-K56	37 pin male	Digital B Telemetry
P6	1721490-5	DDM-50P-NMB-K56	50 pin male	Analog Telemetry

3.1.2.6 Pin Designations

Connector pin designations and shielding requirements for the spacecraft harness shall be as shown in Table 3.

3.1.2.7 Intra-Instrument Harness Requirements

NONE

3.1.2.8 Connector Location and Access

The interface connectors to the spacecraft harness shall be located on the +Z face of the instrument, and shall not extend beyond the instrument envelope dimensions.

3.1.3 Power

3.1.3.1 Power Sources

(1) The main power required by the AMSU-B instrument shall be taken from the +28-Volt Main Bus.

(2) The +28-Volt Pulse Load Bus shall be used to supply power to the motors and heaters in the AMSU-B.

(3) The +28-Volt Analog Telemetry Bus may be used for Telemetry information which is needed when the instrument is not powered and which is not critical to the mission if this bus is lost. (See Para. 3.1.3.3).

(4) All command and Science Data Interfaces shall be powered from the +10.0-Volt Interface Bus.

(5) The power drawn from the above sources shall not exceed values in Table 4. The total power from all the buses shall not exceed 90.0 watts worst-case end of life orbit average.

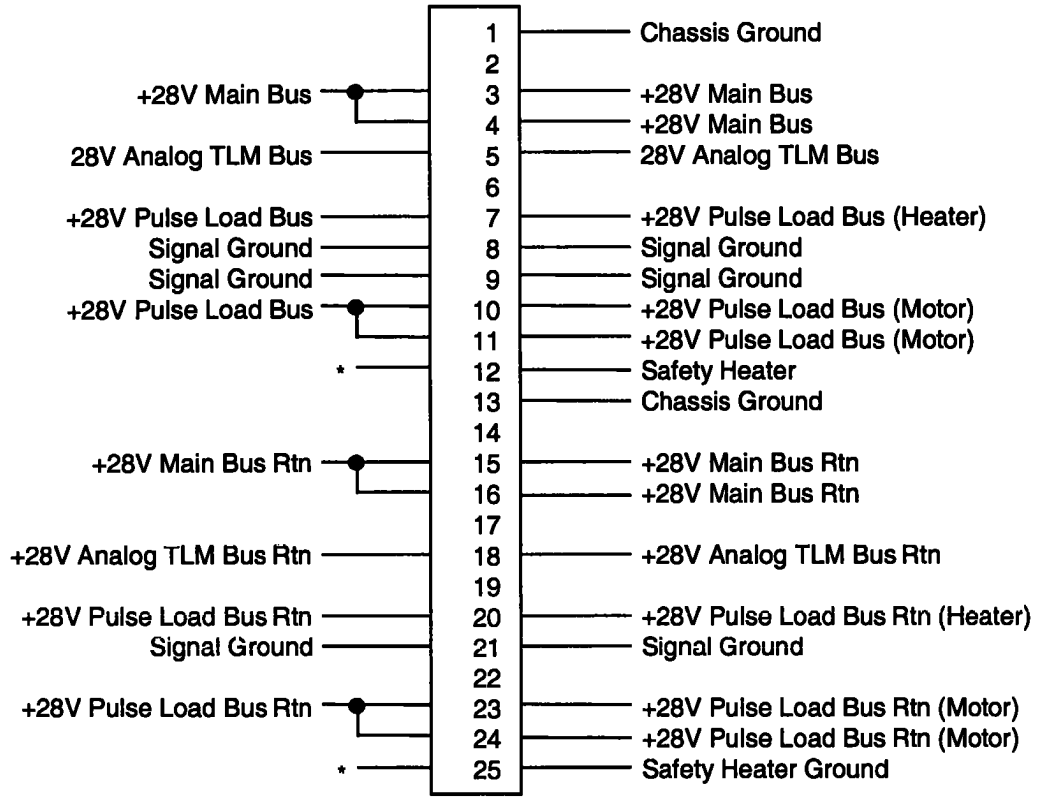
3.1.3.2 +28-Volt Main Bus Power Requirements

3.1.3.2.1 Power Dissipation

The power required by the instrument from the +28 Volt Main Bus shall be as shown in Table 4. The peak power worst-case profile on the +28 Volt Main Bus for this instrument shall be as shown in Figure 1.

TABLE 3A. CONNECTOR PIN DESIGNATIONS

Connector: B-J1 Power



*Pigtails on spacecraft harness for the AMSU-B safety heater (for use in thermal vacuum at GE).

TABLE 3B. CONNECTOR PIN DESIGNATIONS

Connector: B-J2 AIP/Digital

Spacecraft AMSUB-P2		AMSU-B J2
	1	Chassis Ground
	2	Data Clock (C)
	3	Data Enable (A)
SPG	4	
	5	Data Output
	6	
	7	
	8	8 Sec Sync
	9	Chassis Ground

TABLE 3C. CONNECTOR PIN DESIGNATIONS

Connector: B-J3 1.248 MHz Clock

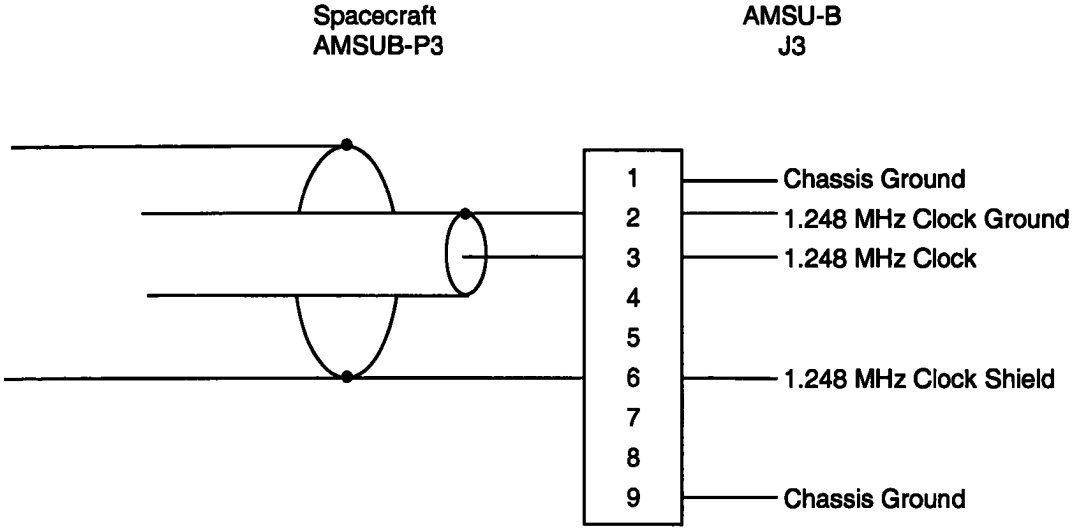


TABLE 3D. CONNECTOR PIN DESIGNATIONS

Connector: B-J4 Command

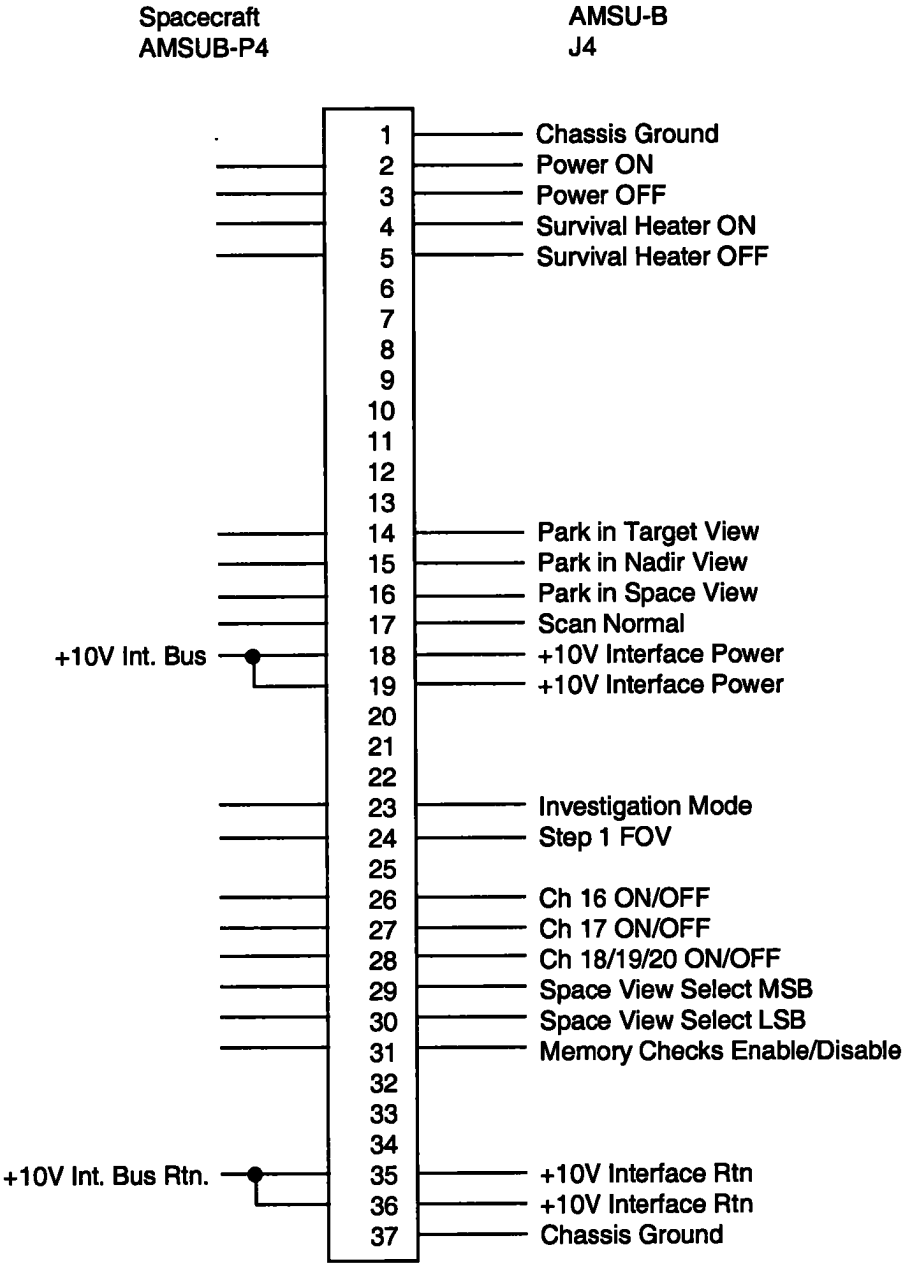


TABLE 3E. CONNECTOR PIN DESIGNATIONS

Connector: B-J5 Digital B Telemetry

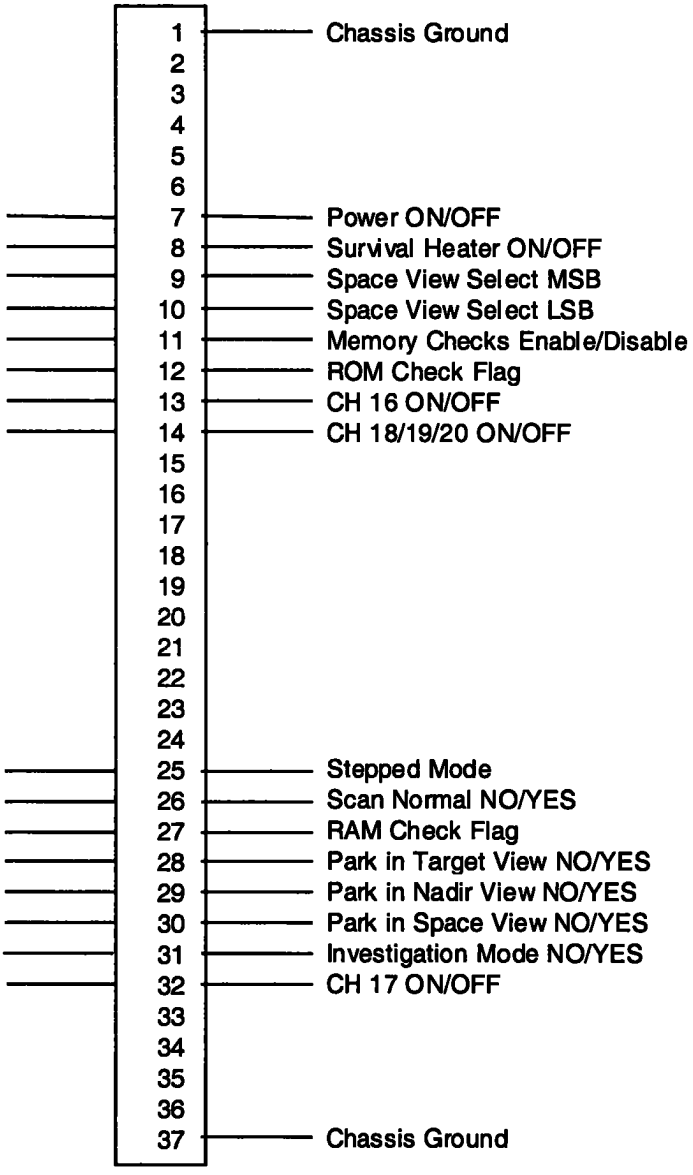
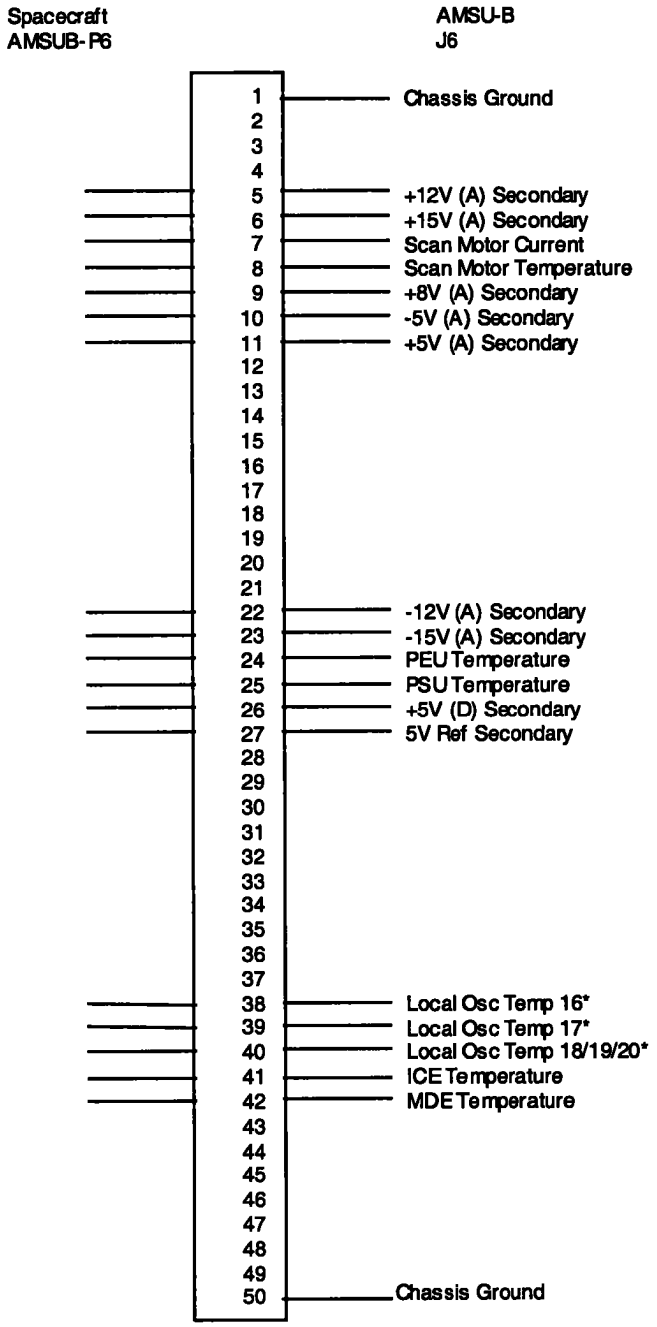


TABLE 3F. CONNECTOR PIN DESIGNATIONS

Connector: B-J6 Analog Telemetry



*Powered by the +28 Volt Analog Telemetry Bus

TABLE 4. AMSU-B POWER REQUIREMENTS

+28V Main Bus		+28V Pulse Load Bus (Motor)		+28V Pulse Load Bus (Heater)		+10V Bus		+28V Analog TM Bus	
Avg. (watts)	Peak Current (amp)	Avg. (watts)	Peak Current (amp)	Avg.** (watts)	Peak Current (amp)	Avg. (watts)	Peak Current (amp)	Current (watts)	Peak Current (amp)
70	2.5	13	3.0	25	0.9	0.1	0.01	0.1	0.01

**NOTE: The AMSU-B heater (25W avg.) is only used during survival conditions in which the AMSU-B and AMSU-B motor are not operating. Thus, the orbit average power will not exceed 90 watts.

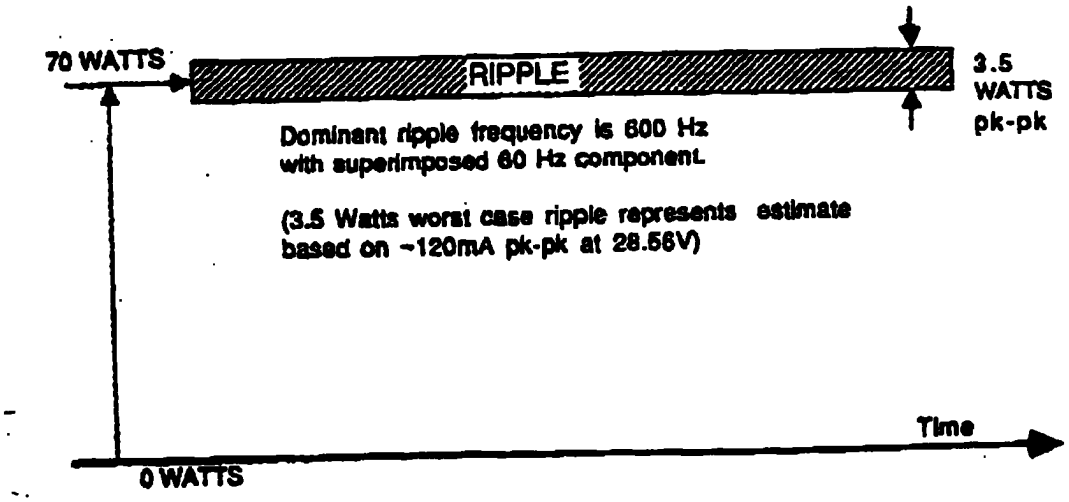


Figure 1. +28-Volt Main Bus Peak Power Worst Case Profile (Steady State)

3.1.3.2.2 Power Limiting

The instrument shall not limit the short circuit current drain on the spacecraft +28-Volt Main Bus. The instrument will be serviced by a circuit fused in the spacecraft with a 7 ampere fuse.

3.1.3.2.3 Load Current Ripple

The typical load current ripple on each line shall be as shown in Figure 2. The load current ripple is 121 mA which exceeds the GIIS (Section 3.1.3.2.6.1) specification of 2 percent of the maximum average steady-state current drawn by the instrument from the +28-volt Main Bus.

3.1.3.2.4 Transient Loads

(1) For fuse sizing purposes, the worst-case transient load on each line shall be as depicted in Figures 3A and 3B.

(2) Refer to Section 3.1.3.2.6.3 of the GIIS (IS-3267415). Typical load current transients shall be as shown in Figure 4.

(3) The worst case peak current on the +28V Main Bus is 4.1 amps for approximately 20 msec.

3.1.3.2.5 DC/DC Converter Frequency

78 kHz

3.1.3.3 +28-Volt Analog Telemetry Bus Power Requirements

The +28-Volt Analog Telemetry Bus may be used for telemetry information which is needed when the instrument is not powered and which is not critical to the mission if this Bus is lost. Other analog TLM should be powered from the 28-Volt Main Bus.

3.1.3.3.1 Power Dissipation

The power required by the instrument from the +28-Volt Analog Telemetry Bus shall be as shown in Table 4.

There are three telemetry circuits on this bus.

3.1.3.3.2 Power Limiting

The instrument shall limit the short circuit current drain on the spacecraft +28-Volt Analog Bus to 0.01 amperes.

3.1.3.3.3 Transient Loads

The +28-volt Analog Telemetry Bus is supplied to all users from a common fused circuit. The worst-case possible loading on this bus produced by all users in combination must fall within the rating of this fused circuit. In order to ensure that this condition is met, any transient load current drawn by the instrument from the +28-Volt Telemetry Bus, including initial power application and instrument turn-on, shall not exceed 150% of the maximum average steady-state current.

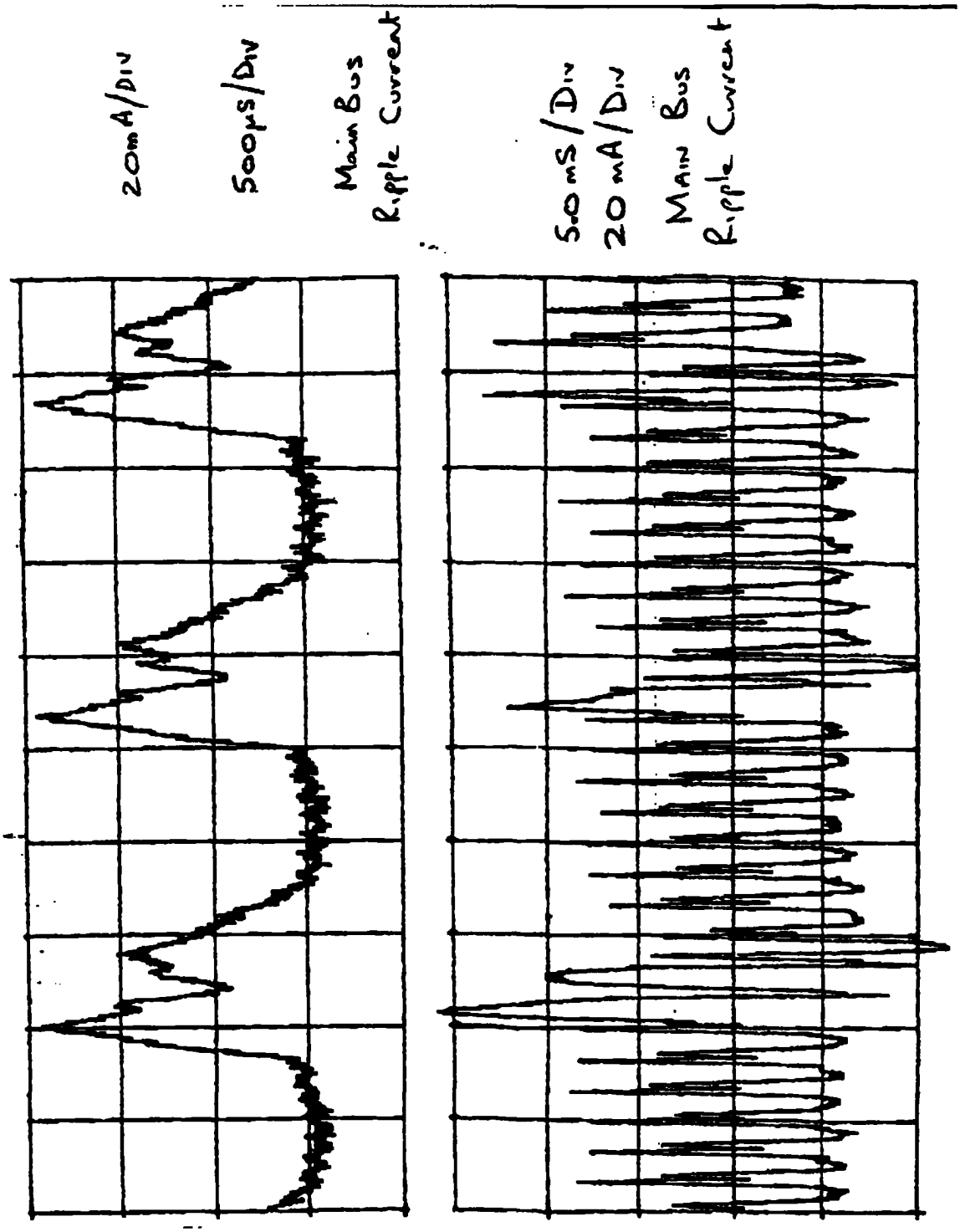


Figure 2. Typical Load Current Ripple (+28V Main Bus)

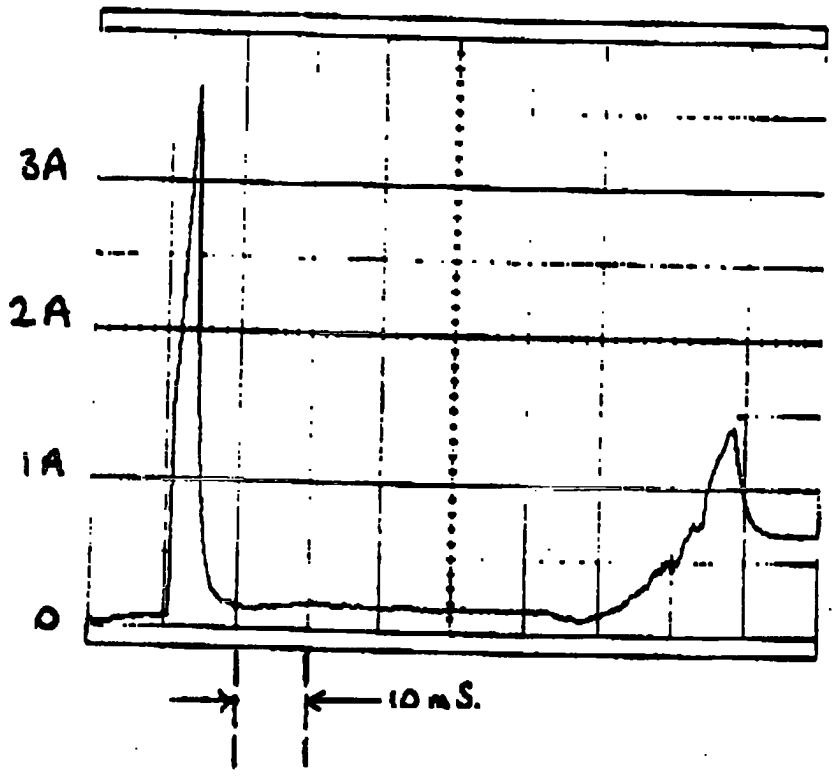
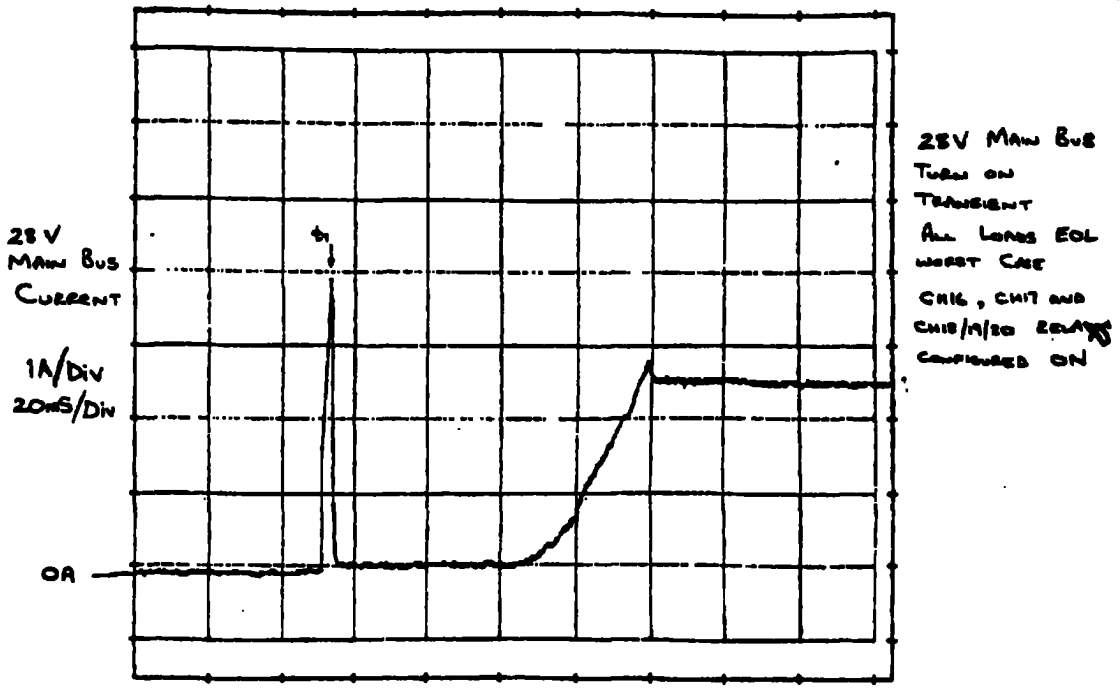


Figure 3A. Typical Transient Load at +28V Turn-On (Main Bus)



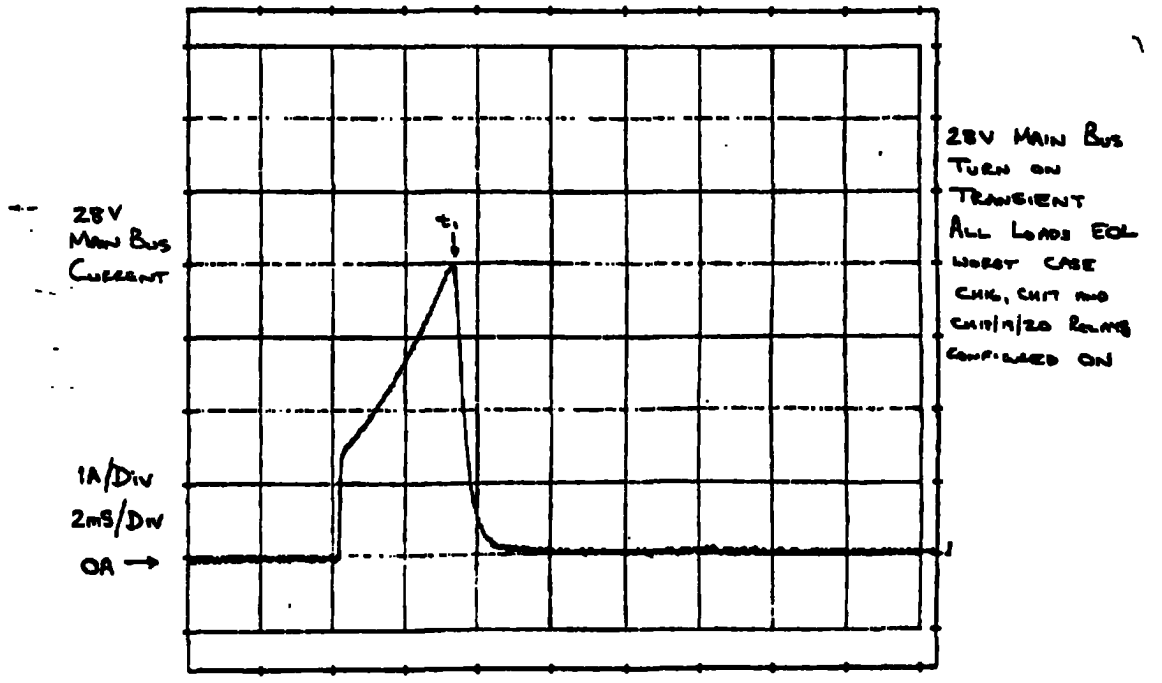


Figure 3B. Worst Case Transient Load (+28V Main Bus)

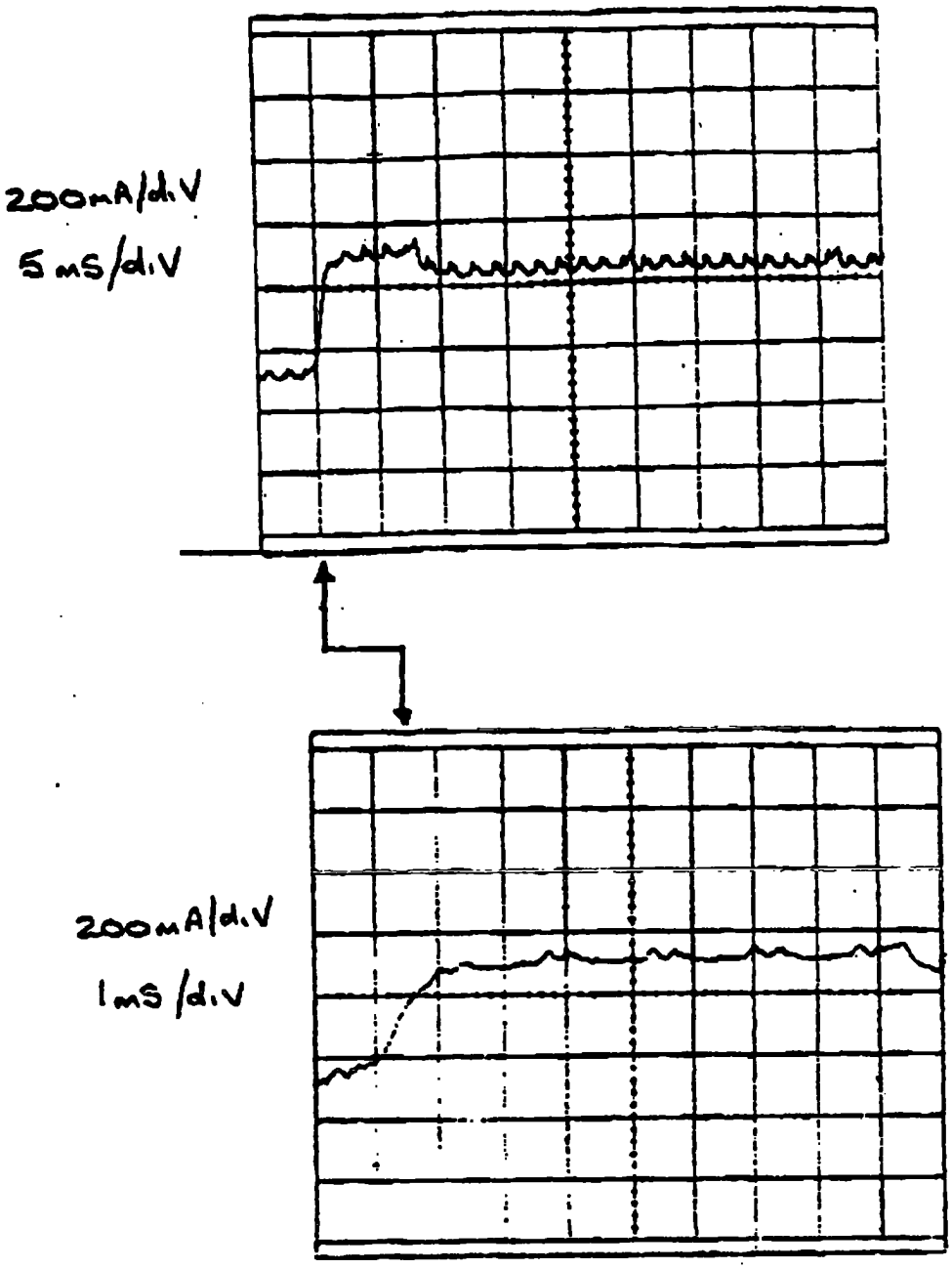


Figure 4. Typical Load Current Transient (+28V Main Bus-Ch 18/19/20 Turn-On Transient)

3.1.3.4 +28-Volt Pulse Load Bus Power Requirements

3.1.3.4.1 Power Dissipation

(1) The power required by the instrument from the +28-Volt Pulse Load Bus shall be as given in Table 4.

(2) The average heater power required by the instrument from the +28-Volt Pulse Load Bus shall be as follows: 25 watts

(3) The peak power worst-case profile on the +28-Volt Pulse Load Bus for this instrument shall be as shown in Figure 5.

3.1.3.4.2 Power Limiting

(1) The instrument will be serviced by one 5 ampere rated fuse (survival heater) and one 5 ampere rated fuse (scan motor) in the spacecraft which shall not be tied together within the instrument.

(2) The instrument shall not limit the short circuit current drain on the spacecraft +28-Volt Pulse Load Bus so as to prevent blowing the spacecraft fuse in the event of a failure within the instrument.

3.1.3.4.3 Transient Loads

(1) See GIIS (IS-3267415) Sections 3.1.3.4.6.1 and 3.1.3.4.6.2.

(2) Typical waveforms, including transients, for load currents drawn from the +28-Volt Pulse Load Bus during different instrument operating modes shall be as shown in Figure 6.

(3) Motor start-up current loads shall not exceed 3.0 ampere maximum. Typical motor start-up current loads shall be as shown in Figure 7A.

(4) The worst case peak current on the +28V Pulse Load Bus is 3.0 amps for approximately 2.6 seconds. This situation would occur as a result of an instrument failure where the scanning mechanism became jammed prior to automatic power down.

3.1.3.4.4 Load Current Ripple

The typical load current ripple on each line shall be as shown in Figure 7B. The measured fundamental frequency is 19.5 kHz, which conflicts with the GIIS requirement (Section 3.1.3.4.6.3) that this frequency not be a submultiple of 121.5 MHz $\pm$15 kHz.

3.1.3.5 +10.0-Volt Interface Bus Power Requirements

3.1.3.5.1 Power Dissipation

The power required by the instrument from the +10.0-Volt Interface Bus shall be as given in Table 4.

3.1.3.5.2 Power Limiting

The instrument shall limit the short circuit drain from the spacecraft +10-Volt bus to 100 milliamperes by use of the RC filter described in Section 3.1.3.5 of the General Instrument Interface Specification, IS-3267415.

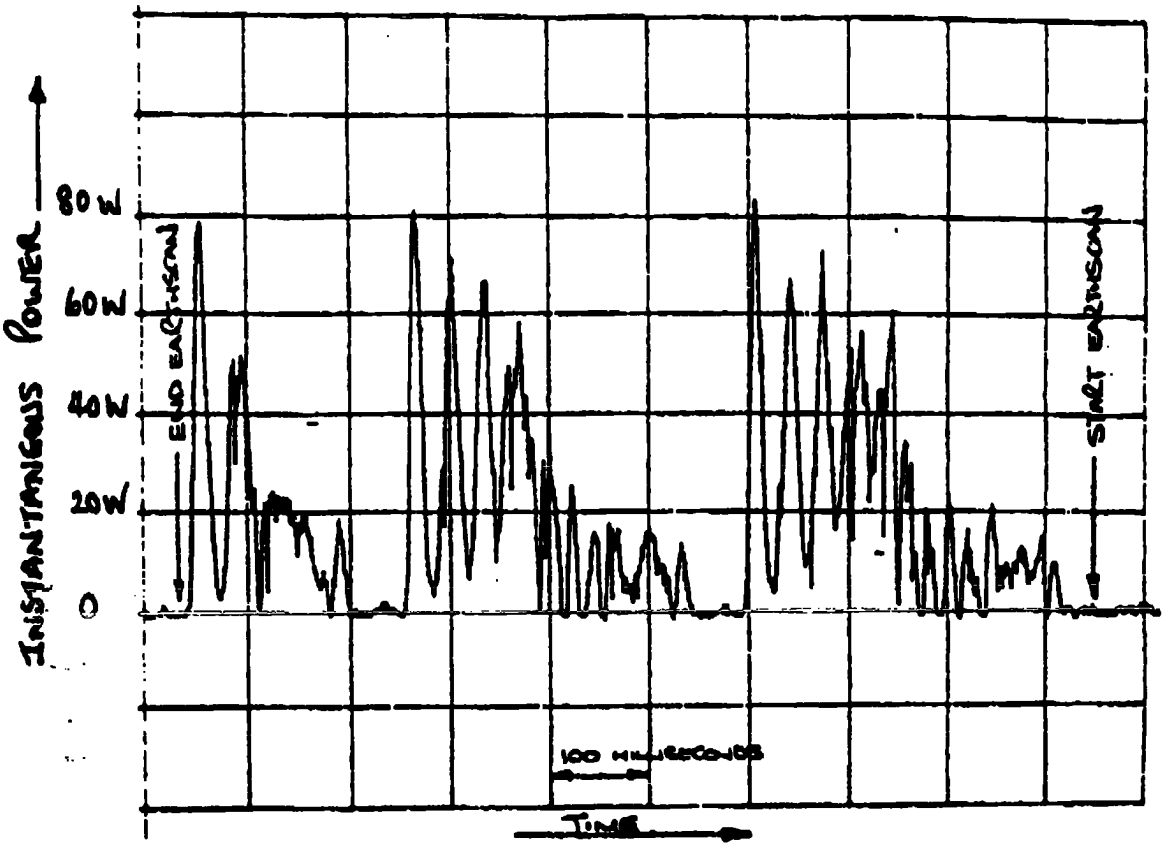


Figure 5. +28-Volt Pulse Load Bus Peak Power Worst-Case Profile

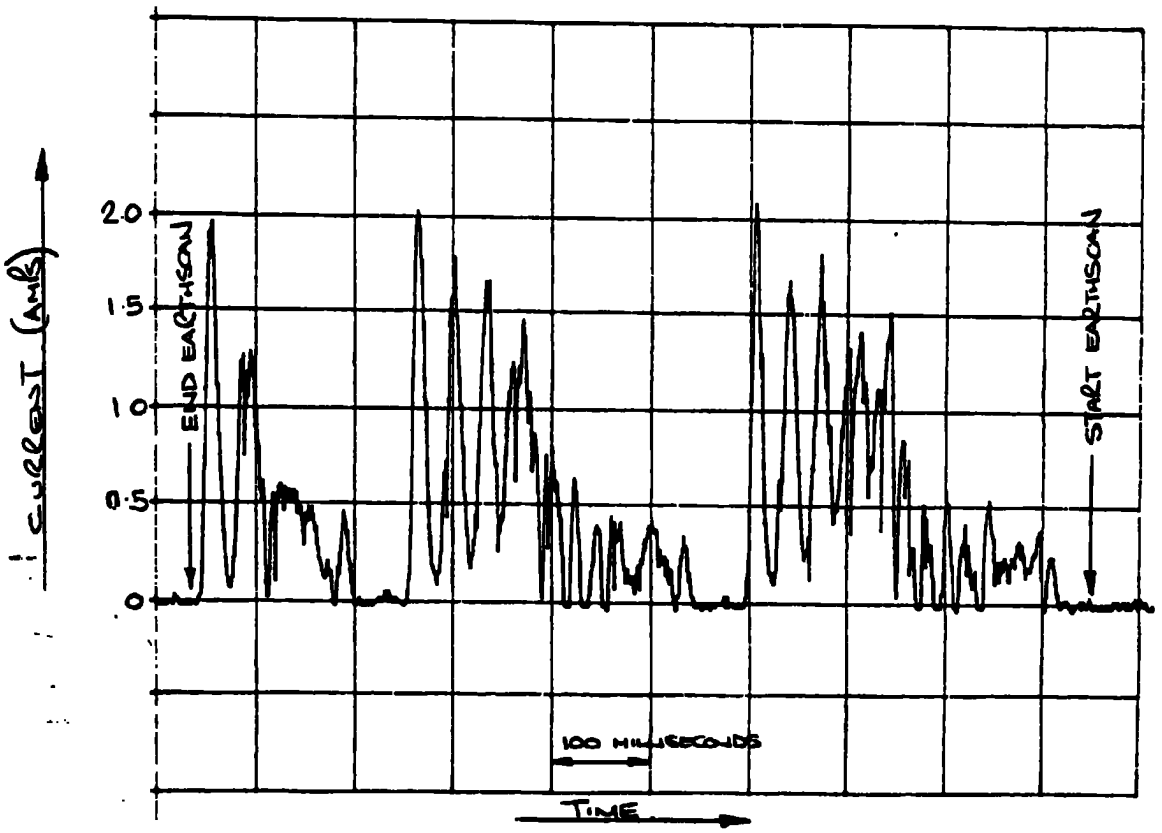
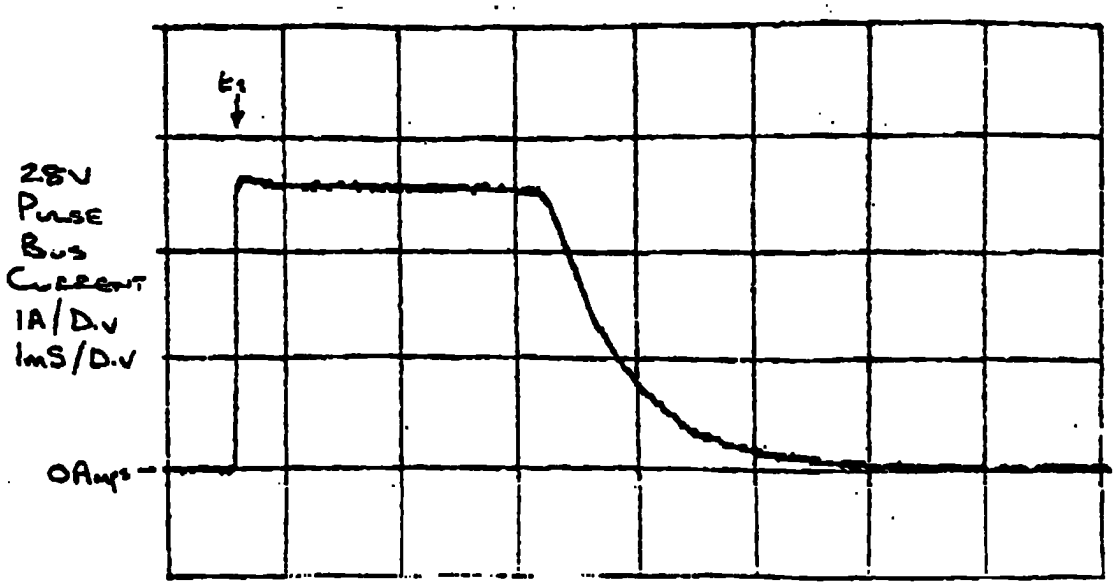


Figure 6. Typical Load Current Waveforms from +28-Volt Pulse Load Bus



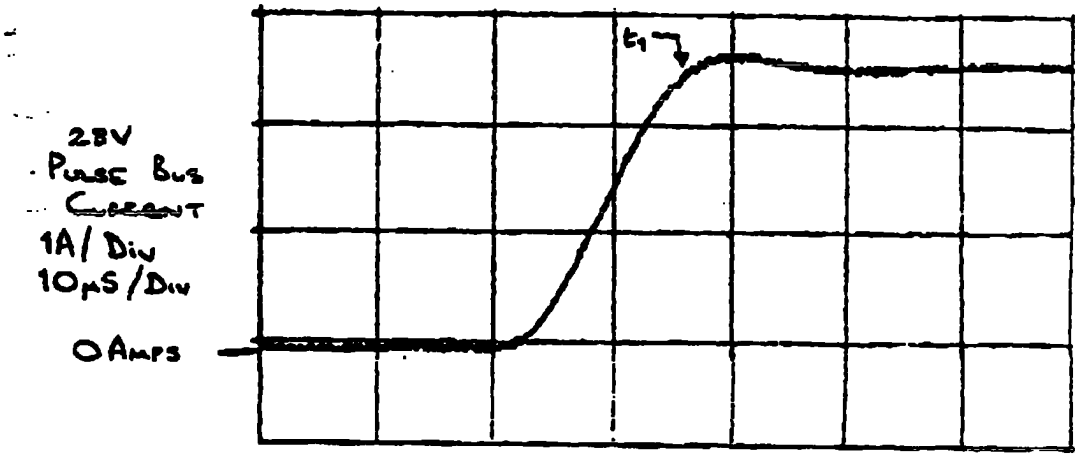


Figure 7A. +28V Pulse Load Bus Motor Drive Electronics
Turn-On Transient (Typical)

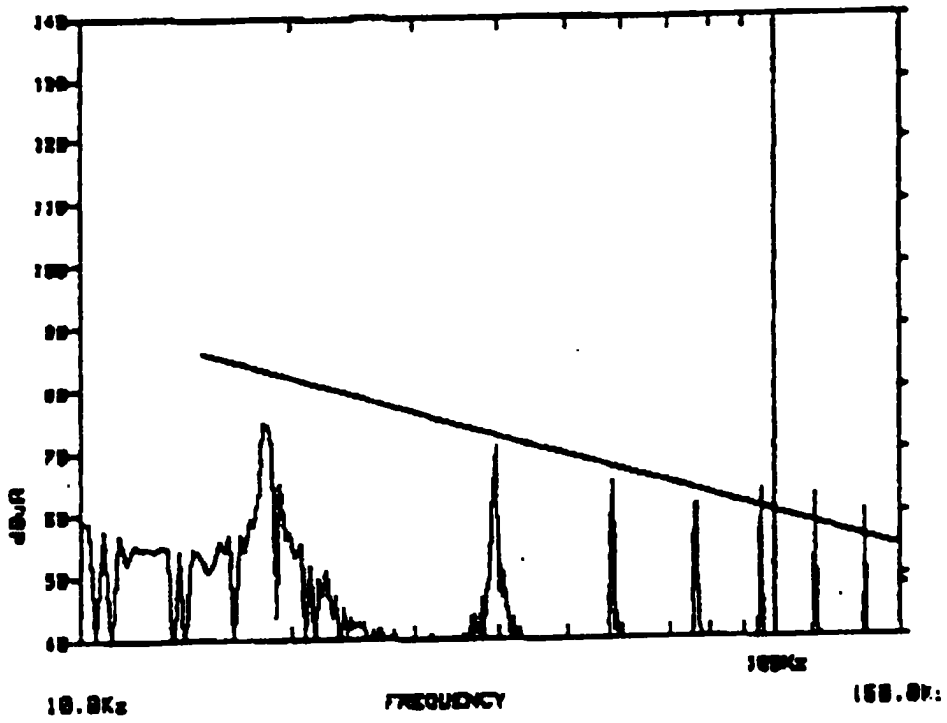


Figure 7B. Typical +28V Pulse Load Bus Ripple Current

3.1.3.5.3 Transient Loads

(1) Load current transients drawn by the instrument shall not exceed 125% of the maximum steady state current drawn from the +10-Volt bus and shall not exceed 50 milliseconds in duration.

(2) Typical load current transients and ripple shall be as shown in Figure 8A. The load current ripple is 5.0 mA which exceeds the GIIS (Section 3.1.3.5.5) specification of 5 percent of the maximum average steady-state current drawn by the instrument from the +10V Bus.

3.1.3.5.4 Exceptions

The +10 volt bus is used for Digital B signals which must correctly indicate power status (instrument power and survival heater power) with the instrument power off (Ref. GIIS Sec. 3.1.3.5). The interface circuit is shown in Figure 8B.

The instrument uses three parallel conditioning circuits which violates the GIIS (Section 3.1.3.5) requirement for one conditioning network for each 10 mA of current drawn from the +10-volt bus. (The total current drawn by the instrument from the +10V Bus is 10 mA.)

3.1.3.6 Power Exceptions

The instrument shall conform to the power requirements of Section 3.1.3 of the General Instrument Interface Specification, IS-3267415. The exceptions to the above specification are as follows:

(1) 3.1.3.2.3 The load current ripple on the +28V Main Bus is 121 mA.

(2) 3.1.3.4.3 Motor start-up current loads shall be limited to 3.0 ampere maximum.

(3) 3.1.3.4.3 The worst case peak current on the +28V Pulse Load Bus is 3.0 amps for approximately 2.6 seconds.

(4) 3.1.3.5.3 The load current ripple on the +10V Bus is 5.0 mA.

(5) 3.1.3.5.4 The +10V bus is used for the instrument power status and the survival heater power status Digital B signals.

(6) The instrument uses three conditioning networks for the 10 mA drawn from the +10V Bus.

3.1.4 Input Timing and Control Signals

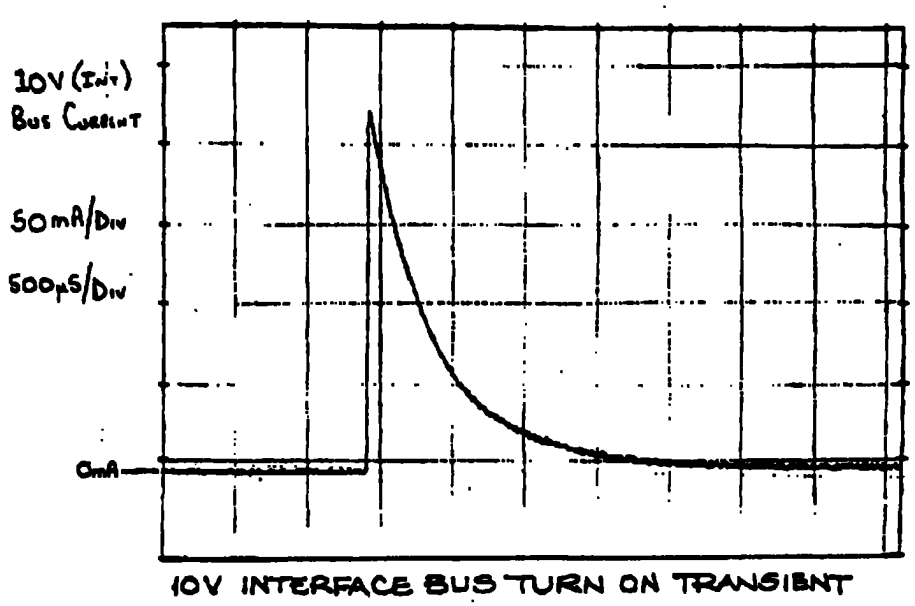
The spacecraft will provide the following input timing and control signals to the instrument. See Figure 9A.

3.1.4.1 Clocks

The spacecraft clocks used by the AMSU-B shall be as shown in Table 5 The characteristics of these clock lines are detailed in Section 3.1.4.3 of the General Instrument Interface Specification, IS-3267415.

The function of these clocks in the instrument shall be as follows:

(1) 1.248 MHz - Synchronization of timing of instrument functions to the spacecraft clock.



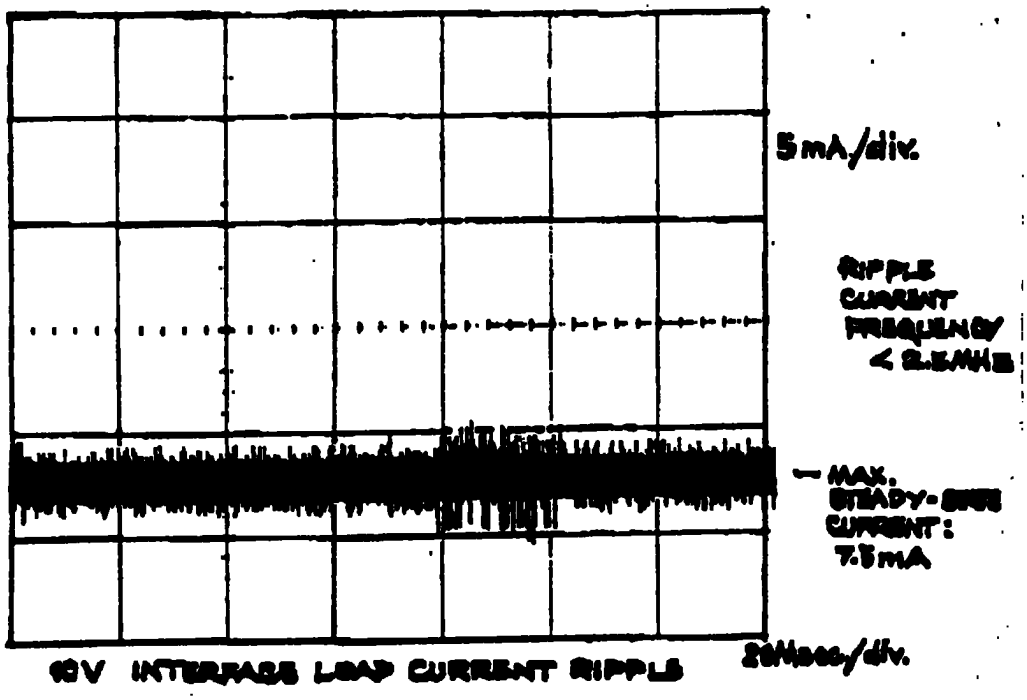
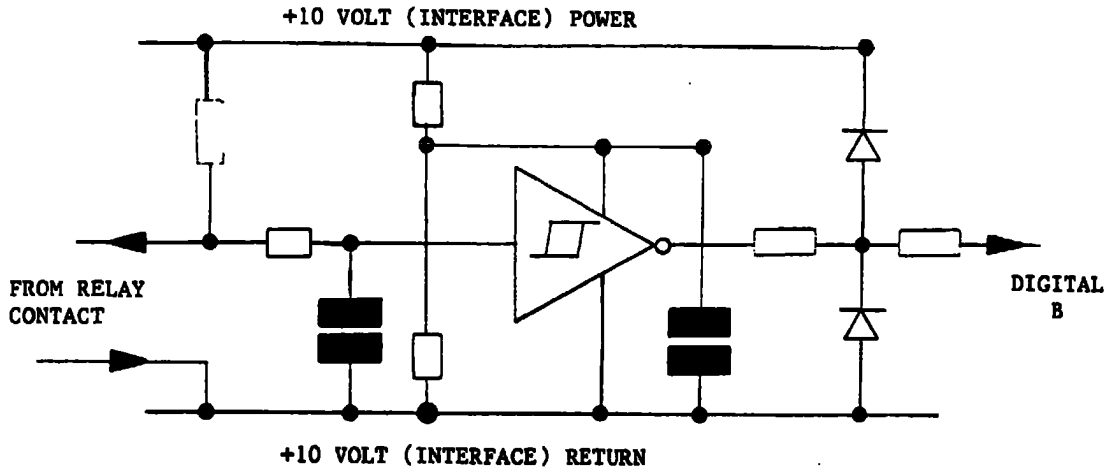


Figure 8A. Typical 10-Volt Bus Load Current Transients and Ripple



NOTE: For power status and survival heater power status only. All other Digital B Telemetry is powered from AMSU-B secondary supplies, and is not available when the instrument is off.

Figure 8B. Digital B Telemetry Interface Circuit

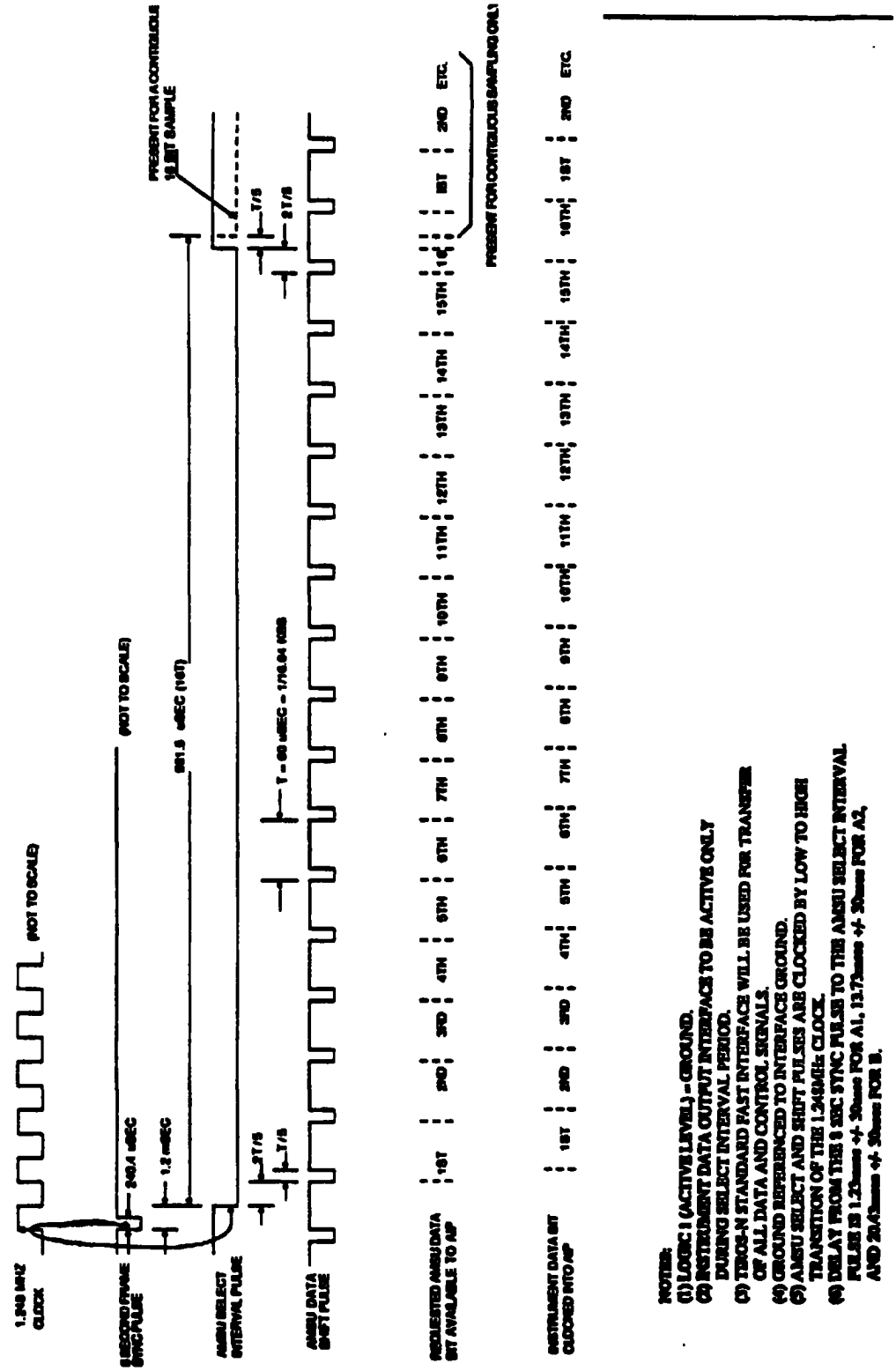


Figure 9A-1. AIP Digital Interface (16.64 KBS)

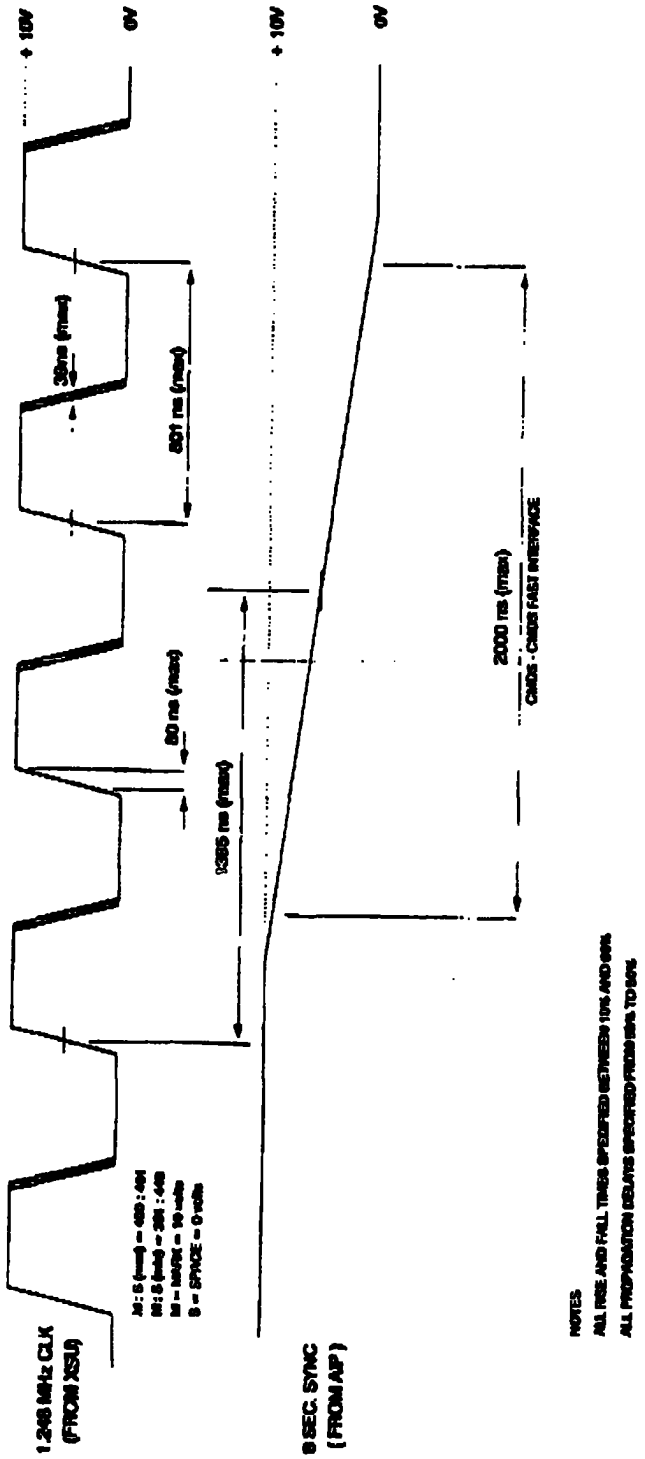


Figure 9A-2. Spacecraft Clock to 8 Second Sync Skew

TABLE 5. SPACECRAFT/AMSU-B CLOCK INTERFACES

Clock	Signal* Characteristics	Standard Interface	Interface Logic Element	Source	Function
1.248 Mhz	Para. 3.1.4.2.3	High Speed	CD 4000B Series	XSU	See Para. 3.1.4.1.

*See Referenced Paragraph in IS-3267415.

TABLE 6. SPACECRAFT/AMSU-B SYNCHRONIZATION SIGNAL INTERFACES

Sync	Repetition Rate	Pulse Width	Std. Interface (1)	Source
Data Enable	25/100 msec	961.5 µsec	B	AIP
Data Clock	16.64 kHz	60 µsec	B	AIP
8 sec sync	8 sec	240.4 µsec	B	AIP

NOTES: 1. Interface circuits are A = slow, B = fast.

2. AMSU-B shall not be enabled during the first and last AIP minor frames (1 and 80).

3.1.4.2 Synchronization Signals

The spacecraft synchronization signals used by the AMSU-B shall be as shown in Table 6 and Figures 9A-1 and 9A-2.
The functions of these sync signals in the instrument are as follows:

(1) Major Frame - Not Used
(2) 8 Second Sync - to synchronize the instrument output data format with the start of each AIP frame.
(3) 128-Second Sync - Not Used
(4) 256-Second Sync - Not Used
(5) Data Enable Pulse - enables readout of the AIP minor frame words.
(6) Data Clock - clocks the instrument output data into the AIP.

3.1.4.2.1 AIP Switchover

The AMSU-B will continue to operate to specification if one side of the AIP fails; but, if the redundant side starts up with a random phase 8 second sync with respect to the original sync, the scan will be out of sync. The AMSU-B software detects the error and sets a flag in the digital telemetry.

3.1.4.3 Commands

3.1.4.3.1 General Requirements

The spacecraft will provide the command inputs listed below to the AMSU-B. The general characteristics of these commands are detailed in Section 3.1.4.2 of the General Instrument Interface Specification (IS-3267415).

For "Level" commands, the "ON", "TRUE", or "LOW" level will be indicated by a logic "1" or zero-volt level. The "OFF", "FALSE", or "HIGH" level will be indicated by a Logic "0" or +10 volt level for CMOS logic.

The AMSU-B shall be provided 10 pulse discrete and 6 level discrete commands. The total number of commands required by the AMSU-B is 16.

The pulse discrete commands will have a pulse width of 60 $\pm$5 milliseconds, which is adequate for operating relays. The pulse discrete and level discrete commands will be supplied from separate eight bit parallel output buffers. Only one bit can be changed with one spacecraft command sequence; serial spacecraft commands are required to change multiple bits.

All commands shall be verified through telemetry; major commands shall be verified through Digital B telemetry.

The spacecraft level AMSU-B command mnemonics will be as shown in Table 7.

Further details on the functions of each command are given in Table 7 and in the following paragraphs.

TABLE 7. SPACECRAFT/AMSU-B COMMAND INTERFACES

CMD #	Description	Command Mnemonic	Command Type
1	Power ON	ABPON	Pulse
2	Power OFF	ABPOF	Pulse
3	Survival Heater ON	ABSHN	Pulse
4	Survival Heater OFF	ABSHF	Pulse
5	Scan Normal	ABSCN	Pulse
6	Park in Target View	ABPTV	Pulse
7	Park in Nadir View	ABPNV	Pulse
8	Park in Space View	ABPSV	Pulse
9	Investigation Mode	ABINV	Pulse
10	Step 1 FOV	ABSTP	Pulse
11	Channel 16 ON/OFF	AB16N/F	Level
12	Channel 17 ON/OFF	AB17N/F	Level
13	Channel 18/19/20 ON/OFF	AB18N/F	Level
14	Space View Select (MSB) LO/HI	ABSML/H	Level
15	Space View Select (LSB) LO/HI	ABSLL/H	Level
16	Memory Checks Enable/Disable	ABMCE/D	Level

3.1.4.3.2 Command Description

1) Power ON - Commands power ON to all subsystems. Following a Software Initialization sequence within the AMSU-B Processing Electronics Unit, and upon receipt of a subsequent 8 sec sync pulse, the instrument will enter Scan Normal Mode within 8 seconds. Digital telemetry will comply with Normal format as defined in Section 3.1.5.2.1.

2) Power OFF - Commands Power OFF to all subsystems.

3) Survival Heater ON - Commands the survival heater ON.

4) Survival Heater OFF - Commands the survival heater OFF.

5) Scan Normal - Returns the instrument to Scan Normal Mode from Park, Step, or Investigation modes. Digital telemetry will revert to Normal format as defined in Section 3.1.5.2.1.

6) Park in target view - Parks the antenna in the calibration target view position. Digital telemetry reverts to Park format as defined in Section 3.1.5.2.1.

7) Park in Nadir View - Parks the antenna in the nadir view position. Digital telemetry reverts to Park format as defined in Section 3.1.5.2.1.

8) Park in Space View - Parks the antenna in the currently selected space view position. Digital telemetry reverts to Park format as defined in Section 3.1.5.2.1.

9) Investigation Mode - Similar to scan normal mode except that the antenna views each space view in turn in successive scans regardless of the currently selected space view. Digital telemetry reverts to the normal format as defined in Section 3.1.5.2.1.

10) Step 1 FOV - Steps the antenna position forward by one pixel F.O.V (1.1 degrees) from a previous parked position or stepped position. Digital telemetry reverts to Park format as defined in Section 3.1.5.2.1. Step commands will be processed only once per 8/3 seconds.

11) Channel 16 ON/OFF - Commands Channel 16 power ON or OFF.

12) Channel 17 ON/OFF - Commands Channel 17 power ON or OFF.

13) Channels 18/19/20 ON/OFF - Commands channels 18/19/20 power ON or OFF.

NB: All channels will be off following software initialization.

14) Space View Select (MSB) Low/High

15) Space View Select (LSB) Low/High

These two bits define the required space view during scan normal mode or park in space view mode as follows:

MSB	LSB	
High	High	View 0 (centered on -157 degrees from +Z)
High	Low	View 1 (centered on -161 degrees from +Z)
Low	High	View 2 (centered on -165 degrees from +Z)
Low	Low	View 3 (centered on -169 degrees from +Z)

NOTE: Low - logic "1", zero volt level;
High - logic "0", +10V volt level

NB: Commands 14 and 15 must be strobed by subsequent scan normal or park in space view commands in order to be achieved. Thus to change from park in space view 1 to park in space view 3, the code must be changed and then a further park in space view command sent.

16) Memory Checks Enable/Disable and Scan Control Abort Enable/Disable

1) During PEU software initialization the status of this level Telecommand determines whether the PEU ROM and RAM checks are performed.

2) Following PEU software initialization the Telecommand determines whether the software will abort the scan control task in the event of prolonged restricted motor motion.

In both cases:

TRUE (LOW) - ENABLE
FALSE (HIGH) - DISABLE

NOTE: The instrument's electronics software telecommand processing only allows the instrument to be commanded into the Step Mode from a Parked Mode (Target View, Space View, or Nadir View). If the instrument were commanded into the Step Mode from the Scan Normal Mode or Investigation Mode, then the instrument's electronics software would prevent it from being processed.

3.1.4.4 Exceptions

The Instrument Control Signal Interfaces shall conform to Section 3.1.5 of the General Instrument Interface Specification, IS-3267415. The exceptions to the above specification are as follows:

1) 3.1.4.3.1 The Processing Electronics Unit microprocessor will not be synchronized to any spacecraft clock.

3.1.5 Instrument Output Signals

3.1.5.1 General

The output data signals supplied by the instrument to the spacecraft shall be assignable into three categories -- Digital Data, Digital "B" Telemetry and Analog Telemetry. The specific signals supplied by the AMSU-B shall be as detailed below:

3.1.5.2 Digital Data

Digital data is clocked into the spacecraft AIP at a 16.64 Kbps rate by the shift pulse whenever the Data Enable Pulse is presented to the instrument. The AMSU-B data will be in AIP minor frame words 48 through 97.

The AIP will read the digital data output from the AMSU-B in 16 bit words. The instrument shall not routinely put out as many as sixty 0's or sixty 1's in a row.

The AMSU-B telemetry format shall consist of 78 minor frames of data. Minor frames 1 and 80 in each 8 second cycle shall be blank; i.e., no data shall be available in the PEU digital data FIFO during the first and last minor frames of each 8 second format.

The 78 minor frames shall be organized as 3 blocks of 650 words as follows (representing one scan of the instrument):

36 spare words
540 words of Earth view pixel data
(90 x (5 channels + shaft position at mid-pixel))
26 words of housekeeping data
48 words of space view and target view data
(2 x 4 x (5 channels + shaft position))

This structure is maintained for all modes. In static modes all pixel data locations shall contain the pixel data for the current antenna position.

The AMSU-B digital format is synchronized to the 8 second synchronization pulse. During each minor frame 25 words of data shall be available in the PEU O/P FIFO within 16.7 ms of the start of the minor frame (except in minor frames 1 and 80).

3.1.5.2.1 General Requirements

(1) Content: A description of the digital data is provided in Table 8.

There are two types of digital format which are described in Figure 9B:

a) Normal Format - This format is available in the Scan Normal Mode.

b) Park Format - This format is available in Scan Park and Scan Step modes.

(2) Word Length: 16 bits

(3) Serial Output: 25 - 16 bit words per 100 msec (MSB first)

3.1.5.3 Digital B Telemetry

3.1.5.3.1 General

The Digital B one-bit status telemetry shall be available at the instrument interface at all times. The 3.2 second subcoms generated by the TIP will sample each Digital "B" Telemetry Point once every 3.2 seconds. The characteristics of the Digital "B" telemetry interface are detailed in Sections 3.1.6, 3.1.8.2, and 3.1.8.3 of the General Instrument Interface Specification (IS-3267415).

Words 8 and 12 of the Minor Frame will be dedicated to the sampling of Digital B telemetry from all spacecraft components.

3.1.5.3.2 Digital B Telemetry Points

The AMSU-B instrument will be provided 16 Digital B telemetry points. The Digital B Telemetry Points provided shall be as shown in Table 9.

MINOR FRAME	1	2	3	4	5	6	7	8	9	10
WORD 01		SP1	SP26	17/03	18/07	19/11	20/15	P/20	16/24	17/28
WORD 02		SP2	SP27	18/03	19/07	20/11	P/16	16/20	17/24	18/28
WORD 03		SP3	SP28	19/03	20/07	P/12	16/16	17/20	18/24	19/28
WORD 04		SP4	SP29	20/03	P/08	16/12	17/16	18/20	19/24	20/28
WORD 05		SP5	SP30	P/04	16/08	17/12	18/16	19/20	20/24	P/29
WORD 06		SP6	SP31	16/04	17/08	18/12	19/16	20/20	P/25	16/29
WORD 07		SP7	SP32	17/04	18/08	19/12	20/16	P/21	16/25	17/29
WORD 08		SP8	SP33	18/04	19/08	20/12	P/17	16/21	17/25	18/29
WORD 09		SP9	SP34	19/04	20/08	P/13	16/17	17/21	18/25	19/29
WORD 10		SP10	SP35	20/04	P/09	16/13	17/17	18/21	19/25	20/29
WORD 11		SP11	SP36	P/05	16/09	17/13	18/17	19/21	20/25	P/30
WORD 12		SP12	P/01	16/05	17/09	18/13	19/17	20/21	P/26	16/30
WORD 13	BLANK	SP13	16/01	17/05	18/09	19/13	20/17	P/22	16/26	17/30
WORD 14		SP14	17/01	18/05	19/09	20/13	P/18	16/22	17/26	18/30
WORD 15		SP15	18/01	19/05	20/09	P/14	16/18	17/22	18/26	19/30
WORD 16		SP16	19/01	20/05	P/10	16/14	17/18	18/22	19/26	20/30
WORD 17		SP17	20/01	P/06	16/10	17/14	18/18	19/22	20/26	P/31
WORD 18		SP18	P/02	16/06	17/10	18/14	19/18	20/22	P/27	16/31
WORD 19		SP19	16/02	17/06	18/10	19/14	20/18	P/23	16/27	17/31
WORD 20		SP20	17/02	18/06	19/10	20/14	P/19	16/23	17/27	18/31
WORD 21		SP21	18/02	19/06	20/10	P/15	16/19	17/23	18/27	19/31
WORD 22		SP22	19/02	20/06	P/11	16/15	17/19	18/23	19/27	20/31
WORD 23		SP23	20/02	P/07	16/11	17/15	18/19	19/23	20/27	P/32
WORD 24		SP24	P/03	16/07	17/11	18/15	19/19	20/23	P/28	16/32
WORD 25		SP25	16/03	17/07	18/11	19/15	20/19	P/24	16/28	17/32

MINOR FRAME	11	12	13	14	15	16	17	18	19	20
WORD 01	18/32	19/36	20/40	P/45	16/49	17/53	18/57	19/61	20/65	P/70
WORD 02	19/32	20/36	P/41	16/45	17/49	18/53	19/57	20/61	P/66	16/70
WORD 03	20/32	P/37	16/41	17/45	18/49	19/53	20/57	P/62	16/66	17/70
WORD 04	P/33	16/37	17/41	18/45	19/49	20/53	P/58	16/62	17/66	18/70
WORD 05	16/33	17/37	18/41	19/45	20/49	P/54	16/58	17/62	18/66	19/70
WORD 06	17/33	18/37	19/41	20/45	P/50	16/54	17/58	18/62	19/66	20/70
WORD 07	18/33	19/37	20/41	P/46	16/50	17/54	18/58	19/62	20/66	P/71
WORD 08	19/33	20/37	P/42	16/46	17/50	18/54	19/58	20/62	P/67	16/71
WORD 09	20/33	P/38	16/42	17/46	18/50	19/54	20/58	P/63	16/67	17/71
WORD 10	P/34	16/38	17/42	18/46	19/50	20/54	P/59	16/63	17/67	18/71
WORD 11	16/34	17/38	18/42	19/46	20/50	P/55	16/59	17/63	18/67	19/71
WORD 12	17/34	18/38	19/42	20/46	P/51	16/55	17/59	18/63	19/67	20/71
WORD 13	18/34	19/38	20/42	P/47	16/51	17/55	18/59	19/63	20/67	P/72
WORD 14	19/34	20/38	P/43	16/47	17/51	18/55	19/59	20/63	P/68	16/72
WORD 15	20/34	P/39	16/43	17/47	18/51	19/55	20/59	P/64	16/68	17/72
WORD 16	P/35	16/39	17/43	18/47	19/51	20/55	P/60	16/64	17/68	18/72
WORD 17	16/35	17/39	18/43	19/47	20/51	P/56	16/60	17/64	18/68	19/72
WORD 18	17/35	18/39	19/43	20/47	P/52	16/56	17/60	18/64	19/68	20/72
WORD 19	18/35	19/39	20/43	P/48	16/52	17/56	18/60	19/64	20/68	P/73
WORD 20	19/35	20/39	P/44	16/48	17/52	18/56	19/60	20/64	P/69	16/73
WORD 21	20/35	P/40	16/44	17/48	18/52	19/56	20/60	P/65	16/69	17/73
WORD 22	P/36	16/40	17/44	18/48	19/52	20/56	P/61	16/65	17/69	18/73
WORD 23	16/36	17/40	18/44	19/48	20/52	P/57	16/61	17/65	18/69	19/73
WORD 24	17/36	18/40	19/44	20/48	P/53	16/57	17/61	18/65	19/69	20/73
WORD 25	18/36	19/40	20/44	P/49	16/53	17/57	18/61	19/65	20/69	P/74

Figure 9B. Digital Data Format

MINOR FRAME	21	22	23	24	25	26	27	28	29	30
WORD 01	16/74	17/78	18/82	19/86	20/90	A25	20/S4	SP1	TST09	17/03
WORD 02	17/74	18/78	19/82	20/86	A01	A26	P/T1	SP2	TST10	18/03
WORD 03	18/74	19/78	20/82	P/87	A02	P/S1	16/T1	SP3	TST11	19/03
WORD 04	19/74	20/78	P/83	16/87	A03	16/S1	17/T1	SP4	TST12	20/03
WORD 05	20/74	P/79	16/83	17/87	A04	17/S1	18/T1	SP5	TST13	P/04
WORD 06	P/75	16/79	17/83	18/87	A05	18/S1	19/T1	SP6	TST14	16/04
WORD 07	16/75	17/79	18/83	19/87	A06	19/S1	20/T1	SP7	TST15	17/04
WORD 08	17/75	18/79	19/83	20/87	A07	20/S1	P/T2	SP8	TST16	18/04
WORD 09	18/75	19/79	20/83	P/88	A08	P/S2	16/T2	SP9	TST17	19/04
WORD 10	19/75	20/79	P/84	16/88	A09	16/S2	17/T2	SP10	TST18	20/04
WORD 11	20/75	P/80	16/84	17/88	A10	17/S2	18/T2	SP11	TST19	P/05
WORD 12	P/76	16/80	17/84	18/88	A11	18/S2	19/T2	SP12	P/01	16/05
WORD 13	16/76	17/80	18/84	19/88	A12	19/S2	20/T2	SP13	16/01	17/05
WORD 14	17/76	18/80	19/84	20/88	A13	20/S2	P/T3	SP14	17/01	18/05
WORD 15	18/76	19/80	20/84	P/89	A14	P/S3	16/T3	SP15	18/01	19/05
WORD 16	19/76	20/80	P/85	16/89	A15	16/S3	17/T3	SP16	19/01	20/05
WORD 17	20/76	P/81	16/85	17/89	A16	17/S3	18/T3	SP17	20/01	P/06
WORD 18	P/77	16/81	17/85	18/89	A17	18/S3	19/T3	TST01	P/02	16/06
WORD 19	16/77	17/81	18/85	19/89	A18	19/S3	20/T3	TST02	16/02	17/06
WORD 20	17/77	18/81	19/85	20/89	A19	20/S3	P/T4	TST03	17/02	18/06
WORD 21	18/77	19/81	20/85	P/90	A20	P/S4	16/T4	TST04	18/02	19/06
WORD 22	19/77	20/81	P/86	16/90	A21	16/S4	17/T4	TST05	19/02	20/06
WORD 23	20/77	P/82	16/86	17/90	A22	17/S4	18/T4	TST06	20/02	P/07
WORD 24	P/78	16/82	17/86	18/90	A23	18/S4	19/T4	TST07	P/03	16/07
WORD 25	16/78	17/82	18/86	19/90	A24	19/S4	20/T4	TST08	16/03	17/07

MINOR FRAME	31	32	33	34	35	36	37	38	39	40
WORD 01	18/07	19/11	20/15	P/20	16/24	17/28	18/32	19/36	20/40	P/45
WORD 02	19/07	20/11	P/16	16/20	17/24	18/28	19/32	20/36	P/41	16/45
WORD 03	20/07	P/12	16/16	17/20	18/24	19/28	20/32	P/37	16/41	17/45
WORD 04	P/08	16/12	17/16	18/20	19/24	20/28	P/33	16/37	17/41	18/45
WORD 05	16/08	17/12	18/16	19/20	20/24	P/29	16/33	17/37	18/41	19/45
WORD 06	17/08	18/12	19/16	20/20	P/25	16/29	17/33	18/37	19/41	20/45
WORD 07	18/08	19/12	20/16	P/21	16/25	17/29	18/33	19/37	20/41	P/46
WORD 08	19/08	20/12	P/17	16/21	17/25	18/29	19/33	20/37	P/42	16/46
WORD 09	20/08	P/13	16/17	17/21	18/25	19/29	20/33	P/38	16/42	17/46
WORD 10	P/09	16/13	17/17	18/21	19/25	20/29	P/34	16/38	17/42	18/46
WORD 11	16/09	17/13	18/17	19/21	20/25	P/30	16/34	17/38	18/42	19/46
WORD 12	17/09	18/13	19/17	20/21	P/26	16/30	17/34	18/38	19/42	20/46
WORD 13	18/09	19/13	20/17	P/22	16/26	17/30	18/34	19/38	20/42	P/47
WORD 14	19/09	20/13	P/18	16/22	17/26	18/30	19/34	20/38	P/43	16/47
WORD 15	20/09	P/14	16/18	17/22	18/26	19/30	20/34	P/39	16/43	17/47
WORD 16	P/10	16/14	17/18	18/22	19/26	20/30	P/35	16/39	17/43	18/47
WORD 17	16/10	17/14	18/18	19/22	20/26	P/31	16/35	17/39	18/43	19/47
WORD 18	17/10	18/14	19/18	20/22	P/27	16/31	17/35	18/39	19/43	20/47
WORD 19	18/10	19/14	20/18	P/23	16/27	17/31	18/35	19/39	20/43	P/48
WORD 20	19/10	20/14	P/19	16/23	17/27	18/31	19/35	20/39	P/44	16/48
WORD 21	20/10	P/15	16/19	17/23	18/27	19/31	20/35	P/40	16/44	17/48
WORD 22	P/11	16/15	17/19	18/23	19/27	20/31	P/36	16/40	17/44	18/48
WORD 23	16/11	17/15	18/19	19/23	20/27	P/32	16/36	17/40	18/44	19/48
WORD 24	17/11	18/15	19/19	20/23	P/28	16/32	17/36	18/40	19/44	20/48
WORD 25	18/11	19/15	20/19	P/24	16/28	17/32	18/36	19/40	20/44	P/49

Figure 9B. Digital Data Format (continued)

MINOR FRAME	41	42	43	44	45	46	47	48	49	50
WORD 01	16/49	17/53	18/57	19/61	20/65	P/70	16/74	17/78	18/82	19/86
WORD 02	17/49	18/53	19/57	20/61	P/66	16/70	17/74	18/78	19/82	20/86
WORD 03	18/49	19/53	20/57	P/62	16/66	17/70	18/74	19/78	20/82	P/87
WORD 04	19/49	20/53	P/58	16/62	17/66	18/70	19/74	20/78	P/83	16/87
WORD 05	20/49	P/54	16/58	17/62	18/66	19/70	20/74	P/79	16/83	17/87
WORD 06	P/50	16/54	17/58	18/62	19/66	20/70	P/75	16/79	17/83	18/87
WORD 07	16/50	17/54	18/58	19/62	20/66	P/71	16/75	17/79	18/83	19/87
WORD 08	17/50	18/54	19/58	20/62	P/67	16/71	17/75	18/79	19/83	20/87
WORD 09	18/50	19/54	20/58	P/63	16/67	17/71	18/75	19/79	20/83	P/88
WORD 10	19/50	20/54	P/59	16/63	17/67	18/71	19/75	20/79	P/84	16/88
WORD 11	20/50	P/55	16/59	17/63	18/67	19/71	20/75	P/80	16/84	17/88
WORD 12	P/51	16/55	17/59	18/63	19/67	20/71	P/76	16/80	17/84	18/88
WORD 13	16/51	17/55	18/59	19/63	20/67	P/72	16/76	17/80	18/84	19/88
WORD 14	17/51	18/55	19/59	20/63	P/68	16/72	17/76	18/80	19/84	20/88
WORD 15	18/51	19/55	20/59	P/64	16/68	17/72	18/76	19/80	20/84	P/89
WORD 16	19/51	20/55	P/60	16/64	17/68	18/72	19/76	20/80	P/85	16/89
WORD 17	20/51	P/56	16/60	17/64	18/68	19/72	20/76	P/81	16/85	17/89
WORD 18	P/52	16/56	17/60	18/64	19/68	20/72	P/77	16/81	17/85	18/89
WORD 19	16/52	17/56	18/60	19/64	20/68	P/73	16/77	17/81	18/85	19/89
WORD 20	17/52	18/56	19/60	20/64	P/69	16/73	17/77	18/81	19/85	20/89
WORD 21	18/52	19/56	20/60	P/65	16/69	17/73	18/77	19/81	20/85	P/90
WORD 22	19/52	20/56	P/61	16/65	17/69	18/73	19/77	20/81	P/86	16/90
WORD 23	20/52	P/57	16/61	17/65	18/69	19/73	20/77	P/82	16/86	17/90
WORD 24	P/53	16/57	17/61	18/65	19/69	20/73	P/78	16/82	17/86	18/90
WORD 25	16/53	17/57	18/61	19/65	20/69	P/74	16/78	17/82	18/86	19/90

MINOR FRAME	51	52	53	54	55	56	57	58	59	60
WORD 01	20/90	A25	20/S4	SP1	TST09	17/03	18/07	19/11	20/15	P/20
WORD 02	A01	A26	P/T1	SP2	TST10	18/03	19/07	20/11	P/16	16/20
WORD 03	A02	P/S1	16/T1	SP3	TST11	19/03	20/07	P/12	16/16	17/20
WORD 04	A03	16/S1	17/T1	SP4	TST12	20/03	P/08	16/12	17/16	18/20
WORD 05	A04	17/S1	18/T1	SP5	TST13	P/04	16/08	17/12	18/16	19/20
WORD 06	A05	18/S1	19/T1	SP6	TST14	16/04	17/08	18/12	19/16	20/20
WORD 07	A06	19/S1	20/T1	SP7	TST15	17/04	18/08	19/12	20/16	P/21
WORD 08	A07	20/S1	P/T2	SP8	TST16	18/04	19/08	20/12	P/17	16/21
WORD 09	A08	P/S2	16/T2	SP9	TST17	19/04	20/08	P/13	16/17	17/21
WORD 10	A09	16/S2	17/T2	SP10	TST18	20/04	P/09	16/13	17/17	18/21
WORD 11	A10	17/S2	18/T2	SP11	TST19	P/05	16/09	17/13	18/17	19/21
WORD 12	A11	18/S2	19/T2	SP12	P/01	16/05	17/09	18/13	19/17	20/21
WORD 13	A12	19/S2	20/T2	SP13	16/01	17/05	18/09	19/13	20/17	P/22
WORD 14	A13	20/S2	P/T3	SP14	17/01	18/05	19/09	20/13	P/18	16/22
WORD 15	A14	P/S3	16/T3	SP15	18/01	19/05	20/09	P/14	16/18	17/22
WORD 16	A15	16/S3	17/T3	SP16	19/01	20/05	P/10	16/14	17/18	18/22
WORD 17	A16	17/S3	18/T3	SP17	20/01	P/06	16/10	17/14	18/18	19/22
WORD 18	A17	18/S3	19/T3	TST01	P/02	16/06	17/10	18/14	19/18	20/22
WORD 19	A18	19/S3	20/T3	TST02	16/02	17/06	18/10	19/14	20/18	P/23
WORD 20	A19	20/S3	P/T4	TST03	17/02	18/06	19/10	20/14	P/19	16/23
WORD 21	A20	P/S4	16/T4	TST04	18/02	19/06	20/10	P/15	16/19	17/23
WORD 22	A21	16/S4	17/T4	TST05	19/02	20/06	P/11	16/15	17/19	18/23
WORD 23	A22	17/S4	18/T4	TST06	20/02	P/07	16/11	17/15	18/19	19/23
WORD 24	A23	18/S4	19/T4	TST07	P/03	16/07	17/11	18/15	19/19	20/23
WORD 25	A24	19/S4	20/T4	TST08	16/03	17/07	18/11	19/15	20/19	P/24

Figure 9B. Digital Data Format (continued)

MINOR FRAME	61	62	63	64	65	66	67	68	69	70
WORD 01	16/24	17/28	18/32	19/36	20/40	P/45	16/49	17/53	18/57	19/61
WORD 02	17/24	18/28	19/32	20/36	P/41	16/45	17/49	18/53	19/57	20/61
WORD 03	18/24	19/28	20/32	P/37	16/41	17/45	18/49	19/53	20/57	P/62
WORD 04	19/24	20/28	P/33	16/37	17/41	18/45	19/49	20/53	P/58	16/62
WORD 05	20/24	P/29	16/33	17/37	18/41	19/45	20/49	P/54	16/58	17/62
WORD 06	P/25	16/29	17/33	18/37	19/41	20/45	P/50	16/54	17/58	18/62
WORD 07	16/25	17/29	18/33	19/37	20/41	P/46	16/50	17/54	18/58	19/62
WORD 08	17/25	18/29	19/33	20/37	P/42	16/46	17/50	18/54	19/58	20/62
WORD 09	18/25	19/29	20/33	P/38	16/42	17/46	18/50	19/54	20/58	P/63
WORD 10	19/25	20/29	P/34	16/38	17/42	18/46	19/50	20/54	P/59	16/63
WORD 11	20/25	P/30	16/34	17/38	18/42	19/46	20/50	P/55	16/59	17/63
WORD 12	P/26	16/30	17/34	18/38	19/42	20/46	P/51	16/55	17/59	18/63
WORD 13	16/26	17/30	18/34	19/38	20/42	P/47	16/51	17/55	18/59	19/63
WORD 14	17/26	18/30	19/34	20/38	P/43	16/47	17/51	18/55	19/59	20/63
WORD 15	18/26	19/30	20/34	P/39	16/43	17/47	18/51	19/55	20/59	P/64
WORD 16	19/26	20/30	P/35	16/39	17/43	18/47	19/51	20/55	P/60	16/64
WORD 17	20/26	P/31	16/35	17/39	18/43	19/47	20/51	P/56	16/60	17/64
WORD 18	P/27	16/31	17/35	18/39	19/43	20/47	P/52	16/56	17/60	18/64
WORD 19	16/27	17/31	18/35	19/39	20/43	P/48	16/52	17/56	18/60	19/64
WORD 20	17/27	18/31	19/35	20/39	P/44	16/48	17/52	18/56	19/60	20/64
WORD 21	18/27	19/31	20/35	P/40	16/44	17/48	18/52	19/56	20/60	P/65
WORD 22	19/27	20/31	P/36	16/40	17/44	18/48	19/52	20/56	P/61	16/65
WORD 23	20/27	P/32	16/36	17/40	18/44	19/48	20/52	P/57	16/61	17/65
WORD 24	P/28	16/32	17/36	18/40	19/44	20/48	P/53	16/57	17/61	18/65
WORD 25	16/28	17/32	18/36	19/40	20/44	P/49	16/53	17/57	18/61	19/65

MINOR FRAME	71	72	73	74	75	76	77	78	79	80
WORD 01	20/65	P/70	16/74	17/78	18/82	19/86	20/90	A25	20/S4	
WORD 02	P/66	16/70	17/74	18/78	19/82	20/86	A01	A26	P/T1	
WORD 03	16/66	17/70	18/74	19/78	20/82	P/87	A02	P/S1	16/T1	
WORD 04	17/66	18/70	19/74	20/78	P/83	16/87	A03	16/S1	17/T1	
WORD 05	18/66	19/70	20/74	P/79	16/83	17/87	A04	17/S1	18/T1	
WORD 06	19/66	20/70	P/75	16/79	17/83	18/87	A05	18/S1	19/T1	
WORD 07	20/66	P/71	16/75	17/79	18/83	19/87	A06	19/S1	20/T1	
WORD 08	P/67	16/71	17/75	18/79	19/83	20/87	A07	20/S1	P/T2	
WORD 09	16/67	17/71	18/75	19/79	20/83	P/88	A08	P/S2	16/T2	
WORD 10	17/67	18/71	19/75	20/79	P/84	16/88	A09	16/S2	17/T2	
WORD 11	18/67	19/71	20/75	P/80	16/84	17/88	A10	17/S2	18/T2	
WORD 12	19/67	20/71	P/76	16/80	17/84	18/88	A11	18/S2	19/T2	
WORD 13	20/67	P/72	16/76	17/80	18/84	19/88	A12	19/S2	20/T2	BLANK
WORD 14	P/68	16/72	17/76	18/80	19/84	20/88	A13	20/S2	P/T3	
WORD 15	16/68	17/72	18/76	19/80	20/84	P/89	A14	P/S3	16/T3	
WORD 16	17/68	18/72	19/76	20/80	P/85	16/89	A15	16/S3	17/T3	
WORD 17	18/68	19/72	20/76	P/81	16/85	17/89	A16	17/S3	18/T3	
WORD 18	19/68	20/72	P/77	16/81	17/85	18/89	A17	18/S3	19/T3	
WORD 19	20/68	P/73	16/77	17/81	18/85	19/89	A18	19/S3	20/T3	
WORD 20	P/69	16/73	17/77	18/81	19/85	20/89	A19	20/S3	P/T4	
WORD 21	16/69	17/73	18/77	19/81	20/85	P/90	A20	P/S4	16/T4	
WORD 22	17/69	18/73	19/77	20/81	P/86	16/90	A21	16/S4	17/T4	
WORD 23	18/69	19/73	20/77	P/82	16/86	17/90	A22	17/S4	18/T4	
WORD 24	19/69	20/73	P/78	16/82	17/86	18/90	A23	18/S4	19/T4	
WORD 25	20/69	P/74	16/78	17/82	18/86	19/90	A24	19/S4	20/T4	

Figure 9B. Digital Data Format (continued)

NOTES:

1) The format consists of 80 minor frames (1 to 80). Minor frames 1 and 80 are blank. This means that no data is available in the PEU output FIFO for reading by the AIP and therefore the AIP should not send any sample pulses to AMSU-B during these minor frame periods.

2) The following key applies:

SP :	Spare word (Data is 5555H except for spare words 34, 35, and 36 where the instrument manufacturer has inserted other values for special tests.)
TSTXX:	Test data
P/n :	Shaft position at mid-integration time for FOV n.
16/n :	Integrated output for channel 16 for FOV n.
17/n :	Integrated output for channel 17 for FOV n.
18/n :	Integrated output for channel 18 for FOV n.
19/n :	Integrated output for channel 19 for FOV n.
20/n :	Integrated output for channel 20 for FOV n.
/Sn :	Space view FOV n.
/Tn :	Target view FOV n.
AXX :	Multiplexed Housekeeping data

3) The format structure and definition is identical for all modes. In scanning modes, n, Sn & Tn represent pixel identification. In static modes n, Sn & Tn have no meaning; all data values relate to the IFOV.

Figure 9B. Digital Data Format (Continued)

TABLE 8. AMSU-B DATA WORD DESCRIPTION

Digital sub-multiplexed channels

A01	Unit ID + Flags
A02	Digital B Telemetry
A03	Mixer 16 temperature
A04	Mixer 17 temperature
A05	Mixer 18/19/20 temperature
A06	FET amplifier 16 temperature
A07	FET amplifier 17 temperature
A08	FET amplifier 18 temperature
A09	FET amplifier 19 temperature
A10	FET amplifier 20 temperature
A11	Calibration target temperature 1
A12	Calibration target temperature 2
A13	Calibration target temperature 3
A14	Calibration target temperature 4
A15	Calibration target temperature 5
A16	Calibration target temperature 6
A17	Calibration target temperature 7
A18	Sub-reflector temperature 1
A19	Local Oscillator Monitor Current 16
A20	Local Oscillator Monitor Current 17
A21	Local Oscillator Monitor Current 18/19/20
A22	Local Oscillator 16 temperature
A23	Local Oscillator 17 temperature
A24	Local Oscillator 18/19/20 temperature
A25	PRT Bridge Voltage
A26	PRT Board Temperature

Bit	A01
00	Module ID (LSB)
01	Module ID
02	Module ID
03	Module ID
04	Module ID
05	Module ID
06	Module ID
07	Module ID (MSB)
08	Mode Transition Flag
09	Scan Synchronization
10	Pixel Data Invalid Flag
11	Scan Control Status
12	Processor Check Flag
13	Not Defined
14	Not Defined
15 (MSB)	Not Defined

TABLE 8. AMSU-B DATA WORD DESCRIPTION (Continued)

Module Identification (Bits 00 to 07)

Unit Number	Identification No. (MSB) (LSB)
EM	0000 0000
PFM	0000 0100
FM2	0000 1000
FM3	0000 1100

Mode Transition (Bit 08)
0 - Transition Complete
1 - Transition in progress

Scan Synchronization (Bit 09)
0 - Error < 0.1 degrees at 8 sec. sync pulse
1 - Error ≥ 0.1 degrees at 8 sec. sync pulse

Pixel Data Invalid (Bit 10)
0 - Valid
1 - Invalid

Scan Control Status (Bit 11)
0 - Running
1 - Aborted

Processor Check (Bit 12)
0 - Built-In-Test passed
1 - Built-In Test failed

Bit	A02**
00(LSB)	Power ON/OFF (Relay 1 status)
01	Survival heater ON/OFF (Relay 2 status)
02	Scan normal mode
03	Parked in target view mode
04	Parked in nadir view mode
05	Parked in space view mode
06	Investigation mode
07	Stepped Mode
08	Channel 16 ON/OFF (Relay 3 status)
09	Channel 17 ON/OFF (Relay 4 status)
10	Channel 18/19/20 ON/OFF (Relay 5 status)
11	Space view select (MSB)
12	Space view select (LSB)
13	Memory checks status
14	ROM check flag
15 (MSB)	RAM check flag

**NOTE: A "1" status indicates "ON" and a "ϕ" status indicates "OFF."

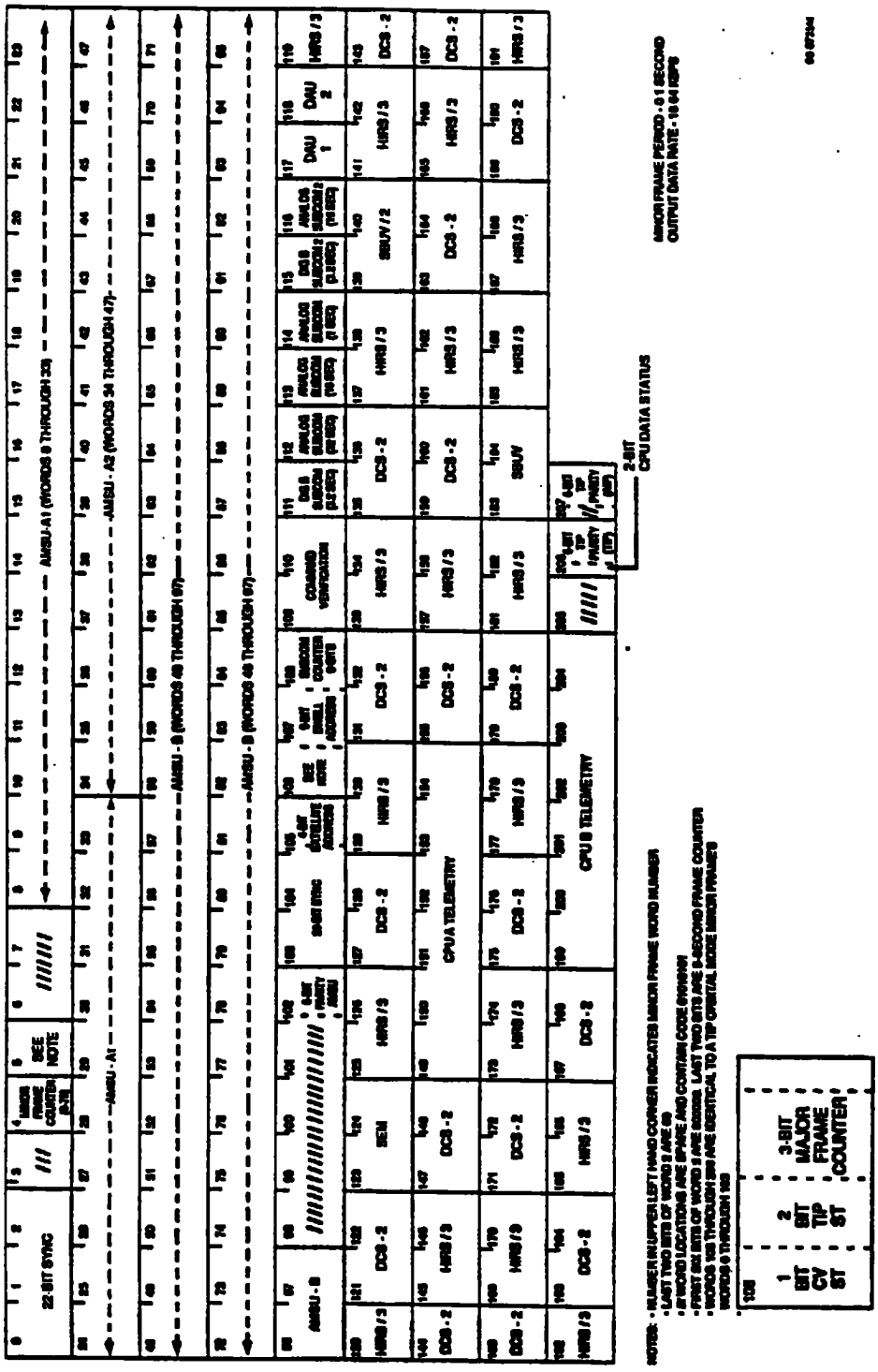


Figure 10. AIP Minor Frame Format

3.1.5.4 Analog Telemetry

3.1.5.4.1 General

A 16 second subcom generated by the TIP, will be used to sample all AMSU-B analog telemetry. The characteristics of the analog telemetry interface are detailed in Sections 3.1.6, 3.1.8.2, and 3.1.8.3 of the General Instrument Interface Specification (IS-3267415).

3.1.5.4.2 Analog Telemetry Points

The Analog Telemetry Points used by the AMSU-B shall be shown in Table 10.

The AMSU-B will be provided 18 Analog Telemetry channels to monitor health and safety.

3.1.5.5 Exceptions

The instrument output signals shall conform to Sections 3.1.6 and 3.1.8 of the General Instrument Interface Specification, IS-3267415. The exceptions to the above specification are as follows:

NONE

3.1.6 Test Points

The test points detailed below will be used as required by the instrument contractor during test of the AMSU-B. These points will not be used by the spacecraft and will not be included in the spacecraft harness. The instrument contractor shall supply flight covers for any Test Connectors.

The Test Point Interface shall conform to Section 3.1.7 of the General Instrument Interface Specification, IS-3267415.

3.1.6.1 Input Test Points

Test points used for supplying test signals to the instrument shall be as shown in Table 11.

3.1.6.2 Output Test Points

Test points displaying signals generated within the instrument shall be as shown in Table 11.

TABLE 9. DIGITAL "B" TELEMETRY

No.	Telemetry Point Name	State* Logic "1"	Logic "0"	CH#
1	Power ON/OFF	ON	OFF	119
2	Survival Heater ON/OFF	ON	OFF	126
3	Scan Normal Mode	YES	NO	127
4	Parked in Target View Mode	YES	NO	134
5	Parked in Nadir View Mode	YES	NO	151
6	Parked in Space View Mode	YES	NO	158
7	Investigation Mode	YES	NO	166
8	Stepped Mode	YES	NO	182
9	Channel 16 ON/OFF	ON	OFF	187
10	Channel 17 ON/OFF	ON	OFF	190
11	Channel 18/19/20 ON/OFF	ON	OFF	191
12	Space View Select (MSB)	Logic 1	Logic 0	197
13	Space View Select (LSB)	Logic 1	Logic 0	213
14	Memory Checks Status	Enabled	Disabled	246
15	ROM Check Flag	Failed	Passed	249
16	RAM Check Flag	Failed	Passed	255

*Logic "1" is a "Low Voltage" State

TABLE 10. AMSU-B ANALOG TELEMETRY

No.	Telemetry Point Name	Range	Scale Factor	CH# (subcom)
1	+12V (A) Secondary	16AN160	12 ±0.72V	279(16-1)
2	-12V (A) Secondary	A16A109	-12 ±0.72V	493(16-2)
3	+15V (A) Secondary	A16A112	15 ±0.15V	496(16-2)
4	-15V (A) Secondary	A16A116	-15 ±0.15V	500(16-2)
5	+8V (A) Secondary	A16A117	8.0 ±0.1V	501(16-2)
6	+5V (D) Secondary	A16A120	5.0 ±0.3V	504(16-2)
7	+5V (A) Secondary	A16A123	5.0 ±0.3V	507(16-2)
8	-5V (A) Secondary	A16A124	-5.0 ±0.3V	508(16-2)
9	+5V Reference Secondary	A16A125	5.0 ±0.05V	509(16-2)
10	ICE Temperature	16AN16	23.3 ±3.5°C	317(16-1)
11	MDE Temperature	16AN17	23.1 ±3.5°C	333(16-1)
12	PEU Temperature	16AN80	25.2 ±3.5°C	365(16-1)
13	PSU Temperature	16AN81	32.5 ±3.5°C	373(16-1)
14	Scan Motor Temperature	16AN8	22.3 ±3.4°C	381(16-1)
15	Scan Motor Current	A16A63	0.1 to 2.9A	447(16-2)
16	Local Oscillator Temperature Ch 16*	A16A99	33.0 ±5.0°C	483(16-2)
17	Local Oscillator Temperature Ch 17*	A16A100	33.0 ±5.0°C	484(16-2)
18	Local Oscillator Temperature Ch 18/19/20*	A16A101	33.0 ±5.0°C	485(16-2)

*Powered by the +28V Analog TLM Bus.
**3 months prior to delivery of any flight model to Lockheed Martin.

TABLE 11. AMSU-B TEST POINTS

No.	Function	Internal Destination

Not Used

3.2 Mechanical Interface

The Instrument Mechanical Interface shall conform to Section 3.2 of the General Instrument Interface Specification, IS-3267415. The exceptions to the above specification are as follows:

(1) 3.2.2.3.1 Accessibility
(2) 3.2.5.1 Alignment Cube Size

3.2.1 Physical Characteristics

3.2.1.1 Dimensions

The AMSU-B shall consist of one unit; the outside dimensions of which, including the mounting feet, shall not exceed the dimensions as shown in Figure 11A. The mounting hole pattern for the AMSU-B shall be as shown in Figure 11B.

The following interface data shall be indicated in the instrument configuration drawing (CPL 556):

(1) Mounting hole location and tolerance
(2) Connector location and keying
(3) Center of gravity location**
(4) Inertia - X, Y, and Z axes
(5) Sunshield location (if one is used)
(6) Harness tie points
(7) Identification marking
(8) Ground Strap (if required)
(9) Location of the optical cube
(10) Reflector location

**Location B17 on sheet 1 of CPL 556 identifies the datum hole from which the Y and Z center of gravity coordinates are calculated. The X datum is assumed to be the underside (-X face) of the AMSU-B baseplate (i.e., nominally 5 mm above the spacecraft front panel).

3.2.1.2 Weight

The total weight of the instrument shall not exceed 132.5 pounds (60 Kg). This total weight shall include mounting and support brackets and the instrument contractor-supplied thermal blankets.

3.2.1.3 Moments of Inertia

The total moments of inertia of the instrument (about the center of gravity) are as follows:

$Ixx = 3.99\ Kg\ M^2$
$Iyy = 3.05\ Kg\ M^2$
$Izz = 3.45\ Kg\ M^2$

3.2.1.4 Disturbance Torque

The AMSU-B disturbance torque is as shown on Figure 11C.

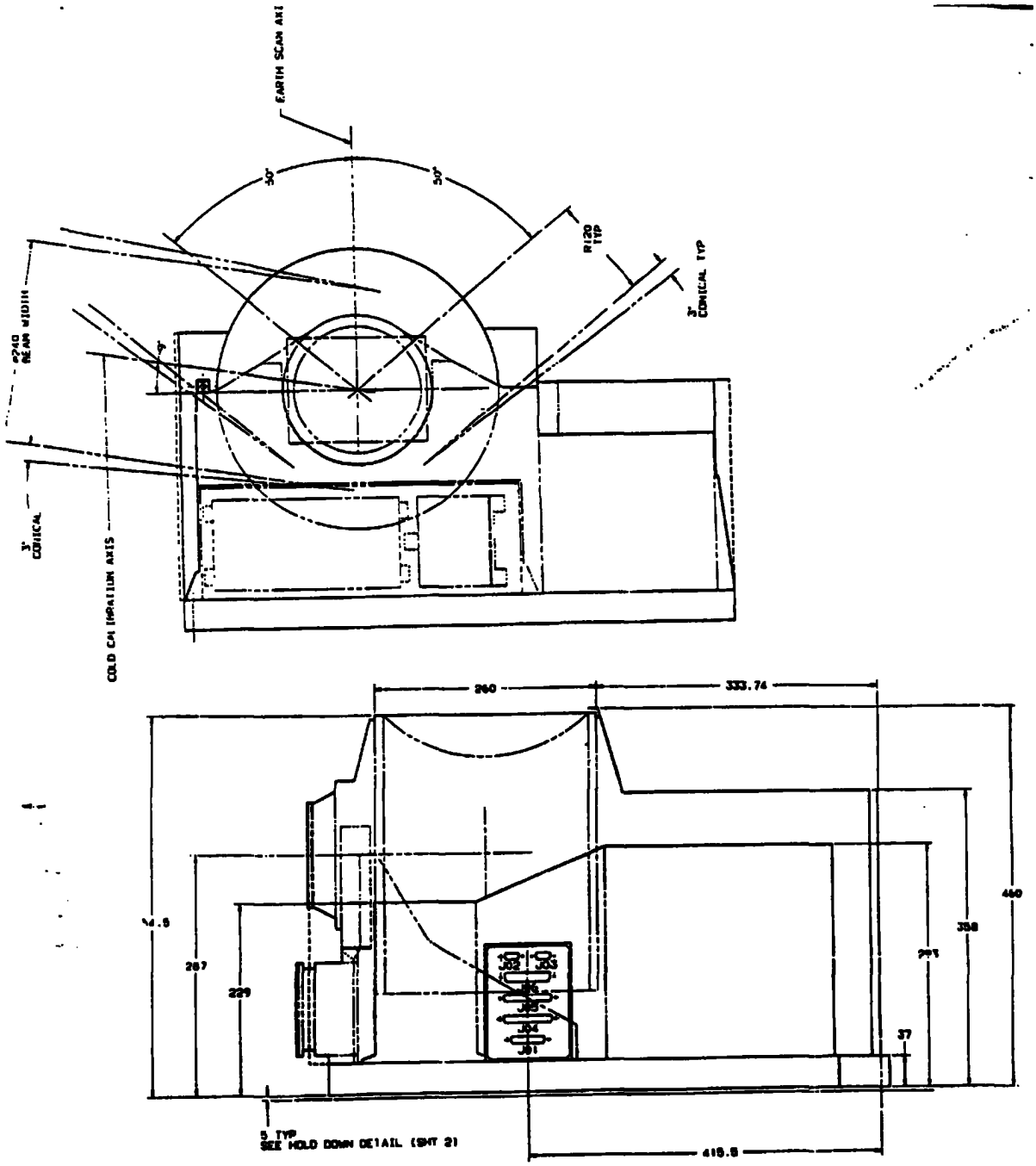


Figure 11A. AMSU-B Outline Drawing

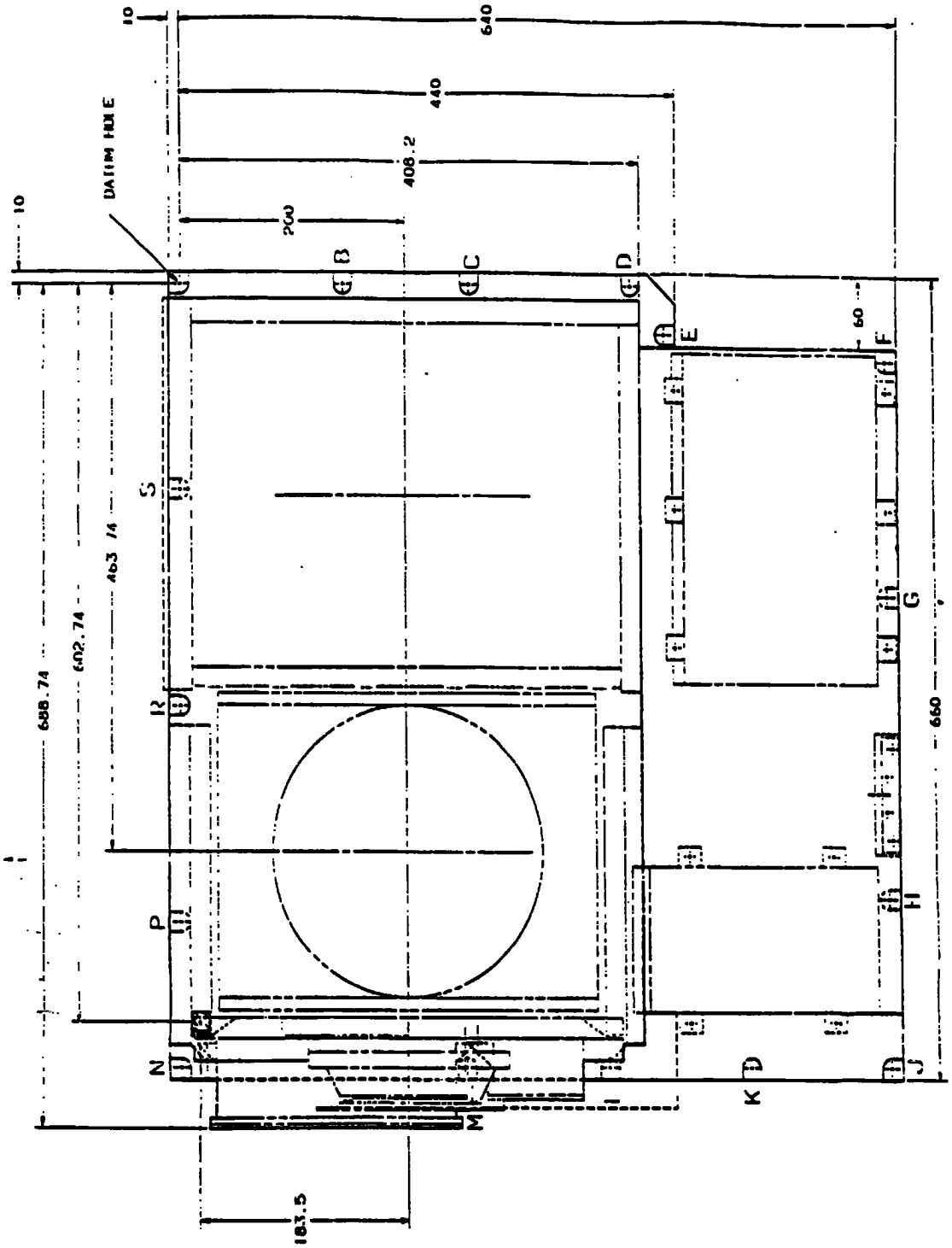


Figure 11B. AMSU-B Mounting Hole Locations

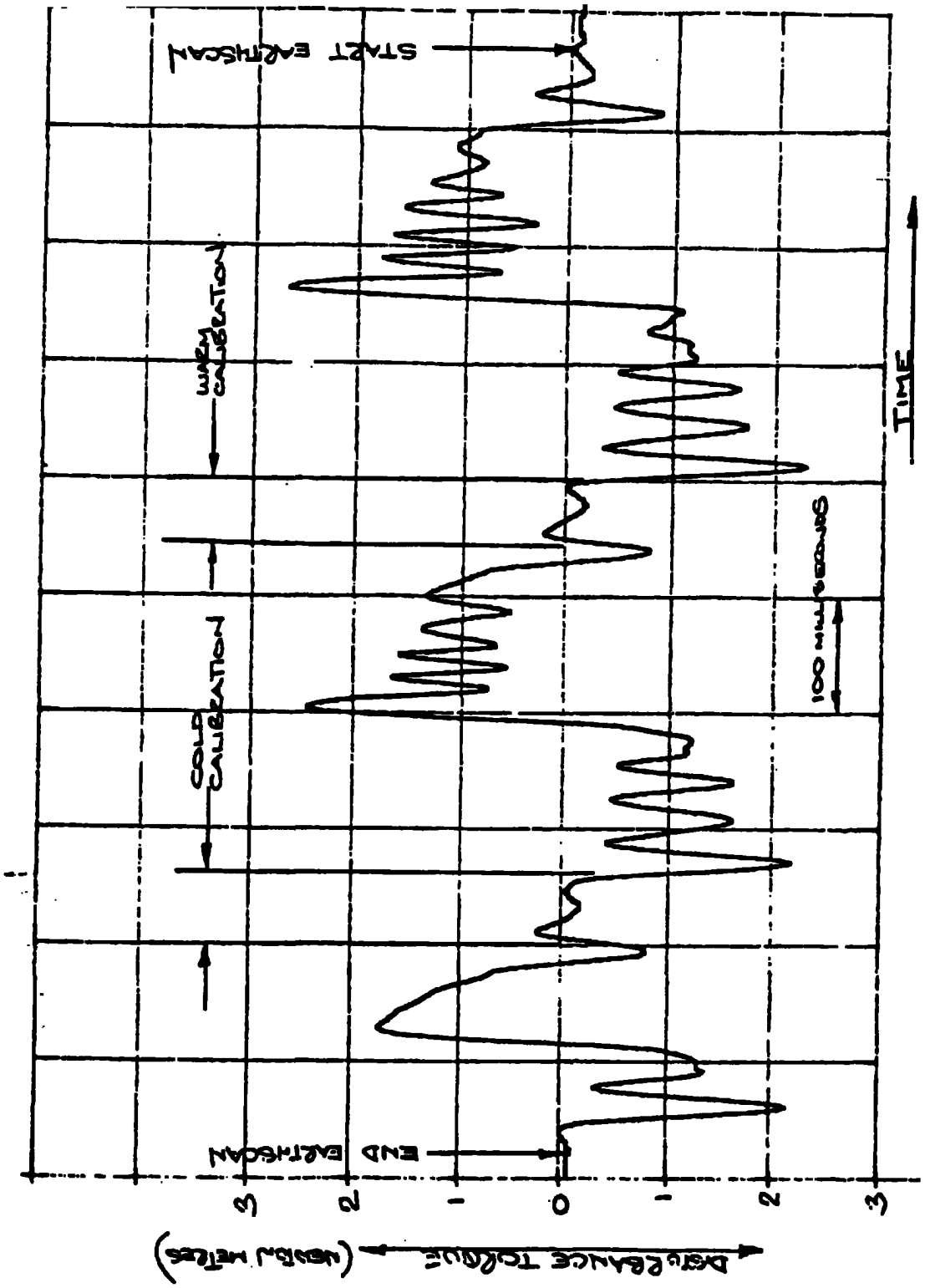


Figure 11C. AMSU-B Torque Profile

3.2.1.5 Center of Gravity

The maximum distance from the instrument's mounting surface to the center of gravity of the AMSU-B shall be no greater than 150 mm (excluding the thickness of thermal isolators). The location of the center of gravity shall be shown on the AMSU-B Outline/Interface Control Drawing No. CPL 556.

3.2.2 Instrument Mounting

3.2.2.1 Instrument Mounting Surface

The instrument mounting flange surfaces shall be within the envelope defined in Para. 3.2.1. It shall be flat within 0.13 mm (0.005 inch) per Section 3.2.2.4 of the General Instrument Interface Specification, IS-3267415. The spacecraft contractor shall shim for flatness along the ESM panel 1/frame edge (+Y) at the AMSU-B interface to within 0.005 inch.

This instrument shall utilize 1/4 inch diameter hardware for mounting purposes. The AMSU-B will be mounted externally to the ESM earth-facing panel through inserts. The pullout strength of these are:

TABLE 12. PULLOUT STRENGTH AND SHEAR FORCE OF INSERT IN ESM EARTH-FACING PANEL

	Pullout Strength		Shear Force	
Hardware Size	(kg)	(pounds)	(kg)	(pounds)
Helicoil Mount	2262	4986	1337	2948
Insert Mount	396	873	1046	2305

3.2.2.2 Mounting Hole Position

The mounting hole positions shall be defined by the AMSU-B drill jig specified below:

Jig	Drawing No.
Spacecraft Pattern	TAA 187

This jig shall have a reference edge parallel to the spacecraft Y-Y axes.

3.2.2.3 Instrument Location

The AMSU-B location and orientation on the spacecraft will be in accordance with the following spacecraft drawings ATN spacecraft assembly (Dwg. 3278200), ATN-KLM ESM assembly (Dwg. 3278776), and KLM Field of View (Dwg. 3278778).

3.2.2.3.1 Accessibility

Certain AMSU-B bolts have limited access and will not conform to sec 3.2.2.1 of the GIIS, IS-3267415. Access restrictions will be identified in the instrument ICD and special tooling will be provided as necessary.

3.2.2.4 Spacecraft Mounting Surface

The spacecraft mounting surface shall conform to the requirements of Section 3.2.2.3 of the General Instrument Interface Specification, IS-3267415.

3.2.3 Mechanisms

3.2.3.1 Caging

All moving mechanical components shall be caged during launch if required. This caging shall be verified with full time telemetry.

3.2.4 Fields-of-View

The required AMSU-B fields-of-view are as follows:

Parameter	Value
(1) Beam Diameter	240 mm
(2) Beam Divergence	6 degrees (± 3 degrees)
(3) Scan Range	-40 to -171 degrees from +Z
(4) Scan Plane	Crosstrack

3.2.4.1 Instrument Requirements

The clear fields-of-view for the instrument provided by the spacecraft will be defined as shown in Table 13 and Figure 12. The "Earth", "Nadir", or "+X" direction shall be the "0" degree reference. The spacecraft velocity vector is in the "-Y" direction.

3.2.4.2 Spacecraft Provisions

The spacecraft will provide the following unobstructed fields-of-view:

-37 to -174 degrees from +Z

3.2.5 Alignment

The instrument alignment shall be in accordance with Section 3.2.3 of the General Instrument Interface Specification, IS-3267415, and shall meet the following requirements:

The in-orbit uncertainties are shown in Table 13A and include uncertainties due to launch, gravity and thermal gradients. The determination of these uncertainties for the AMSU instruments are based on previous analysis. It is expected that the possible movement of the AMSU-A1 and A2 modules due to vibration or launch will be less than shown due to the utilization of shear pins between the module base and the ESM.

To provide for the best possible coregistration between AMSU modules, repositioning of the modules will be required during the initial alignment sequence. The AMSU-A2 module will utilize Lockheed Martin supplied interface plates when mounted to the spacecraft. These plates have been designed to have oversized mounting holes which are required to allow for maximum adjustment (rotation)

about the X-axis. The AMSU-B module, as designed, does not allow for maximum adjustment (rotation) about the X-axis. Adjustment of the AMSU-A2 and -B modules about the Y- and Z-axes will be accomplished via shimming. The AMSU-A1 module, as designed, does not allow for maximum (rotation) about the Z-axis. Adjustment of the AMSU-A1 module about the X- and Y-axes will be accomplished via shimming.

To utilize the available adjustments in the AMSU modules and provide for the best coregistration between modules, the following alignment scenario will be performed:

The AMSU-A1 module will be aligned relative to the primary reference axis (as defined by the ESA) with an initial placement of 0.05 degrees or less in the X- and Y-axes. AMSU-A1 will be placed, accepting the Z-axis position. AMSU-A2 will then be aligned relative to the AMSU-A1 module with an initial placement of 0.05 degrees or less in all three axes. The AMSU-B module will be placed, accepting the X-axis position. AMSU-B will then be aligned relative to the AMSU-A1 module with an initial placement requirement of 0.05 degrees or less in the Y- and Z-axes. The worst case on ground coregistration between the AMSU modules and the ESA will be as shown in Table 13B. Using this method the AMSU modules will be able to meet the in-orbit alignment requirements relative to the primary reference axis as shown in Table 13C with an in-orbit coregistration between the AMSU modules and the ESA as shown in Table 13D.

TABLE 13A. AMSU ON-ORBIT UNCERTAINTIES (WRT ESA)

INST	A	B	C	D	E	F	G	H	I	RSS
A1	0.1	0	0.05	0.0014	0.0014	0.028	0.05	0.025	0.0014	0.1281
A2	0.1	0	0.05	0.0014	0.0014	0.028	0.05	0.083	0.0014	0.1506
B	0.1	0	0.05	0.0014	0.0014	0.028	0.05	0.083	0.0014	0.1506

INSTRUMENT

A: KNOWLEDGE OF INST MIRROR WRT OPTICAL AXIS

B: REPEATABILITY OF INST MIRROR PLACEMENT

C: CHANGE IN INST OPTICAL AXIS DUE TO ENV TEST

SPACECRAFT

D: MEASUREMENT TOLERANCE FROM RPPA TO ESA MIRROR

E: REPEATABILITY OF ESA MIRROR

F: UNCOMPENSATED GRAVITATIONAL TOLERANCE BETWEEN INST

G: CHANGE IN POSITION DUE TO LAUNCH

H: CHANGE IN POSITION TO ON ORBIT THERMAL GRADIENTS

I: MEASUREMENT TOLERANCE FROM RPPA TO INST. MIRROR

TABLE 13B. AMSU INITIAL GROUND COREGISTRATION

Instrument	Initial Placement (Max)	Initial Placement (RSS'D)
ESA/AMSU-A1	0.05°	0.05°
ESA/AMSU-A2	0.10°	0.07°
ESA/AMSU-B	0.10°	0.07°
AMSU-A1/AMSU-A2	0.05°	0.05°
AMSU-A1/AMSU-B	0.05°	0.05°
AMSU-A2/AMSU-B	0.10°	0.07°

TABLE 13C. NEW AMSU ALIGNMENT REQUIREMENTS (WRT ESA)

Inst	Initial Position (1)	Max Alignment Shift Due To Vib (2)	Final Position	Uncertainty (3)	Calculated Requirement
AMSU-A1	< 0.05°	+/- 0.05°	< 0.1°	+/- 0.13°	0.23°
AMSU-A2	< 0.10°	+/- 0.05°	< 0.15°	+/- 0.15°	0.30°
AMSU-B	< 0.10°	+/- 0.05°	< 0.15°	+/- 0.15°	0.30°

1) Sensor Optical Axes WRT S/C Primary Axis

2) Sensor Reference Axes WRT S/C Primary

3) From RSS'D Uncertainty in Table 13A

TABLE 13D. AMSU IN-ORBIT COREGISTRATION

Instrument	Final Position	Uncertainty	In-Orbit Coregistration
ESA/AMSU-A1	0.10°	0.13°	0.23°
ESA/AMSU-A2	0.15°	0.15°	0.30°
ESA/AMSU-B	0.15°	0.15°	0.30°
AMSU-A1/AMSU-A2	0.10°	0.20°	0.30°
AMSU-A1/AMSU-B	0.10°	0.20°	0.30°
AMSU-A2/AMSU-B	0.15°	0.21°	0.36°

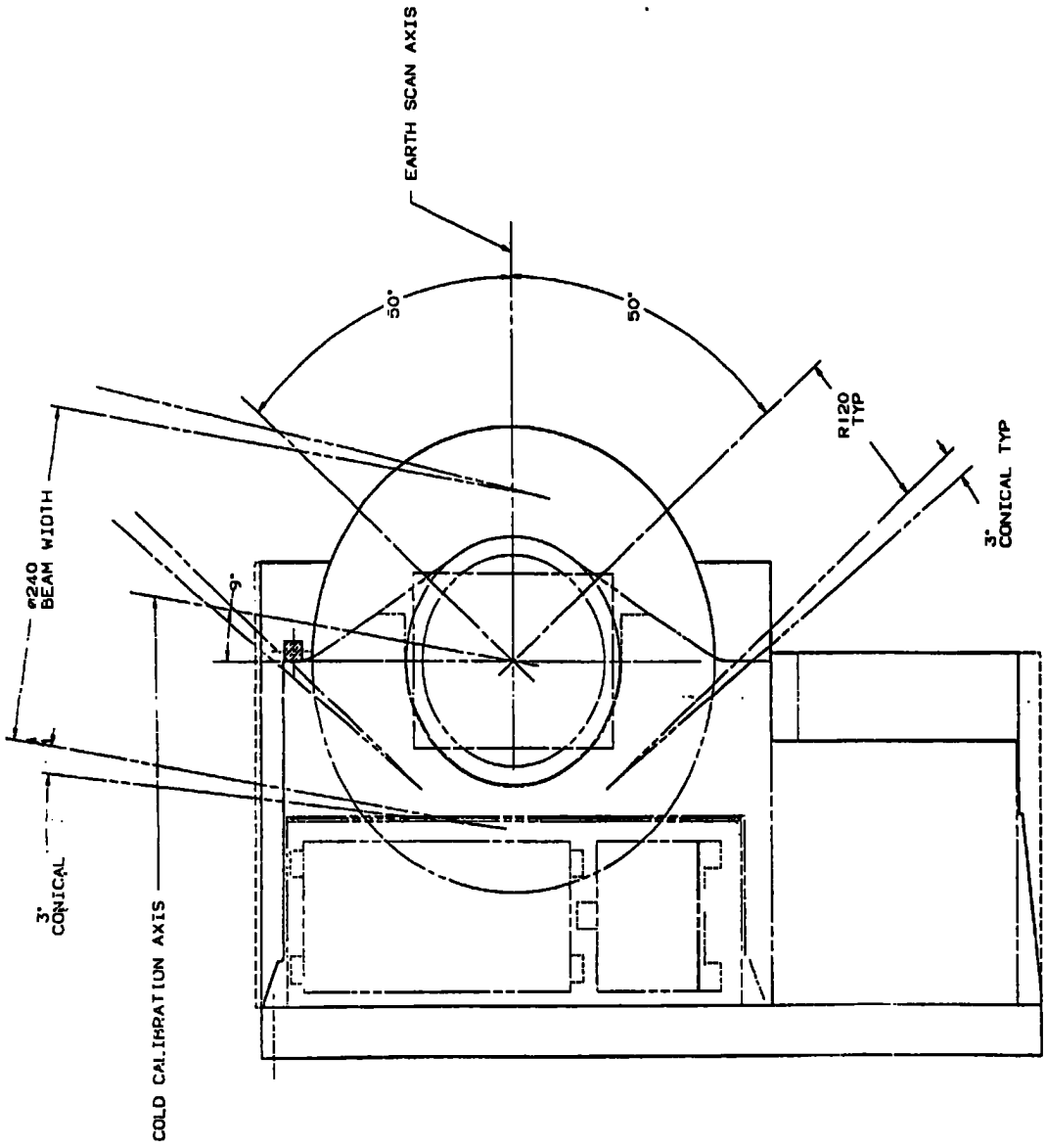


Figure 12. AMSU-B Fields of View

3.2.5.1 Reference Surfaces

The instrument and alignment reference surfaces shall be compatible with Section 3.2.3.3 of the General Instrument Interface Specification, IS-3267415.

(1) Alignment Reference Position with Respect to Optical Axis: Each reference surface shall be placed normal to one of the three planes used to define the instrument optical axis and placed so that it may be sightable from the +Y and +X axes.

(2) Size: 15 mm cube

(3) Orientation: CPL 556

(4) Flatness: ±0.025 mm

3.2.6 Protective Covers

(1) Protective covers for the antenna shall be required for the AMSU-B as follows:
Protective covers shall be red-colored and installed over the rotating portion of the antennas. In addition, the covers shall be labeled as follows: REMOVE BEFORE TESTING. CAUTION: ANTENNA SHROUD CONTAINS BERYLLIUM.
These covers shall meet the specifications in Section 3.2.11 of the General Instrument Interface Specification (IS-326741 5) except that they shall be removed during any operational tests of the AMSU-B at bench test or spacecraft test level, during thermal vacuum test, whenever the instrument is stored or shipped in its shipping container, and when the spacecraft is being moved from one facility to another or is being shipped to the WTR.

(2) Protective covers or bags, when used over the instrument while on the spacecraft, shall be removed before any instrument testing and prior to spacecraft launch.

3.2.6.1 Accessibility

Paragraph 3.2.11 of the General Instrument Interface Specification applies without exception.

3.2.6.2 Installation Requirements

Paragraph 3.2.11 of the General Instrument Interface Specification applies without exception.

3.2.6.3 Removal Requirements and Reasons

Protective covers shall be removed at the launch site prior to mating with the launch, vehicle fairing. The IS-3267415 requirement for covers which are "removable with one hand at the launch site after complete spacecraft assembly and mating to the launch vehicle" is no longer applicable.

3.2.6.4 Precautions

(1) Neither flash photography nor pulsed lasers shall be used in the presence of AMSU-B.

(2) Other handling precautions shall be:

As detailed in Handling Procedures Specification #HPR/AMS/J1890/BAe, Issue 3.

3.2.7 Instrument Materials and Finishes

The instrument materials and finishes shall comply with the General Instrument Interface Specification.

3.2.8 Spacecraft Harness Clamp Requirements

There is no requirement for the instrument contractor to install a spacecraft Harness Clamp to the instrument. If a harness tie-down clamp is required, it will be potted to the instrument, at a mutually acceptable location, at the time of integration of the instrument with the spacecraft.

3.2.9 Marking

Identification and marking shall be in accordance with Section 3.3.7 of the General Instrument Interface Specification, IS-3267415. The following information shall be provided for the AMSU-B. This marking shall be visible when the instrument is mounted on the spacecraft (with the thermal blankets removed).

Equipment Nomenclature
Serial Number
Contract (or Purchase Order) Number
Manufacturer's Name or Trademark
Manufacturer's Part Number

3.3 Thermal Interface

The basic characteristics of the instrument/spacecraft (ESM) interface and the requirements necessary to establish and maintain this interface shall be as follows.

3.3.1 Responsibility

3.3.1.1 Instrument Vendor

The instrument vendor shall be responsible for the thermal design of the instrument.

The instrument vendor shall furnish to the spacecraft contractor a complete documentation package clearly defining the physical outline of the instrument, its multilayered insulation blankets, fixed-area radiators, its louver/radiator assemblies (if any) and its mounting scheme. This documentation shall consist of a set of fully annotated drawings. (Reference AMSU-B Thermal Interface Drawing - CPL 565.)

The instrument vendor shall furnish to the spacecraft contractor a reduced thermal model of the instrument for the purposes of performing systems type thermal analyses.

This reduced thermal mathematical model (TMM) will have 20 nodes including one node to represent the adjacent spacecraft structure. The model will be supplied in tabular form with the following data for each node:

a) Conductive and radiative couplings

b) Minimum/maximum power dissipation for all operating modes

c) Thermal capacity

d) Heat absorbed by each external node at 12 orbit positions for 0°, 27.5° and 80° sun angles

e) Surface areas, solar absorptivities, infra-red emissivities and radiative couplings for all external nodes

The model will be validated against a more detailed TMM to within ±3°C and ±0.5 watts heat transfer to the spacecraft. At least 3 steady state and 3 transient cases shall be used.

SI units shall be used.

3.3.1.2 Spacecraft Contractor

The spacecraft contractor will be responsible for enforcing the requirements and restrictions imposed on the thermal interface.

Interface hardware such as mounting brackets, reinforcement plates, cable insulation and multilayered insulation blankets used for interfacing purposes will be the responsibility of the spacecraft contractor.

The spacecraft contractor will define the interfaces the instrument has with the spacecraft and other instruments. This will include but not be limited to:

- Geometries
- Surface thermo-optical properties
- Surface finishes (diffuse and specular)
- Surface temperatures
- Spacecraft and payload configuration

The spacecraft contractor will define the basic flux parameters to enable the instrument contractor to calculate the fluxes incident on the external surfaces of the instrument. The spacecraft contractor will define all external radiative couplings for all instrument surfaces.

The spacecraft contractor will provide protection against direct line-of-sight between pyrotechnics and the instrument thermal radiators.

3.3.2 General Requirements

The thermal design of the instrument package and its implementation therein shall conform to all of the applicable requirements and restrictions specified in Section 3.4 of IS-3267415 (ATN-KLM General Instrument Interface Specification).

The thermal design of the instrument shall provide for minimal thermal coupling between the instrument and the spacecraft structure (ESM). In particular, the net orbit-average energy transfer rate between the instrument package and the ESM shall not exceed the limits shown in Figure 13. The derived rates from thermal balance tests and the Thermal Math Model deviate from the limits as illustrated, and are worst case rates.

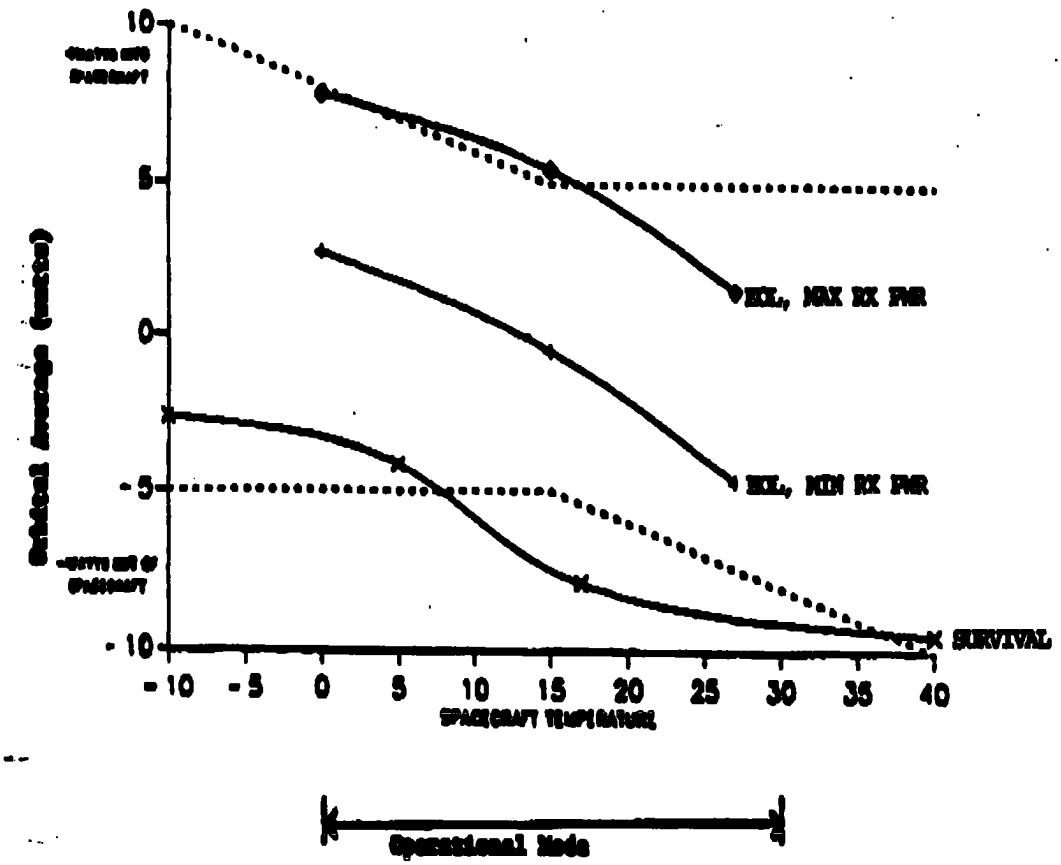
Thermal control of the instrument may utilize both passive and active elements.

3.3.3 Instrument Temperature Requirements

The allowable temperature ranges applicable to the instrument shall be as specified in Table 14. The thermal control provided for the instrument shall maintain the designated point-of-application temperature(s) within these ranges when the instrument is situated in the designated environment.

3.3.4 Spacecraft (ESM) Temperature Specifications

The spacecraft component (ESM) of the thermal interface is temperature-characterized as follows.



ESM/Instrument Interface Temperature (°C)

+ watts into ESM
- watts out of ESM
-----limits

Figure 13. Orbit-Average Energy Transfer
(Worst Case)

TABLE 14. INSTRUMENT ALLOWABLE TEMPERATURE RANGES
(All TBS's are BAe by 1/31/92)

Temperature Range Definition	Range Limits (°C) MIN	MAX	Application Point
(1) Allowable on-orbit operating temperature range; instrument data within specification.	+13.5	+35.1	A05 digital submultiplexed telemetry monitor of the receiver 183 GHz mixer temperature
(2) Allowable on-orbit operating temperature range; instrument data not within specification.	-27	+46	As above
(3) Allowable on-orbit non-operating temperature range; (survival range).	-30	+50	Analog channels 16, 17 and 18
(4) Allowable on-orbit MIN/MAX turn-ON temperatures.	-30	+50	Analog channels 16, 17 and 18
(5) Allowable long term storage temperature range. (Instrument assumed to be in its container, therefore, not "in-air".)	+10	+40	e.g., baseplate reference thermocouple TC010

3.3.4.1 Operational Conditions

ORBITAL SUN-ANGLE	MEAN INTERFACE (ESM) TEMPERATURE (°C)	ORBITAL VARIATION (C°)
0°	13	±1
27.5°	19	±3
80°	23	±3

The interface temperature will be within ±5 degrees C of the mean value shown. The maximum rate of change of this interface temperature will not exceed 5°C per hour at anytime on-orbit.

3.3.4.2 Survival (Safestate) Condition

ORBITAL SUN-ANGLE	MEAN INTERFACE (ESM) TEMPERATURE (°C)	ORBITAL VARIATION (C°)
0°	5	±3
27.5°	10	±3
80°	10	±3

The interface temperature will be within ±5 degrees C of the mean value shown. The maximum rate of change of this interface temperature will not exceed 5 degrees C per hour at anytime on-orbit.

3.3.5 Instrument Thermal Control Components

The following passive and active thermal control elements shall be incorporated within the instrument.

3.3.5.1 Passive Control Elements

3.3.5.1.1 Surface Finishes (External) and Fixed Area Radiators

Details for these items shall be as specified in the following documents:

CPL 565 (2/27/91)

3.3.5.1.2 Multilayered Insulation Blankets

Details for these items shall be as specified in the following document:

CPL 565 (2/27/91)

3.3.5.1.3 Mounting

Instrument mounting details shall be as specified in the following document:

CPL 565 (2/27/91)

3.3.5.2 Active Control Elements

3.3.5.2.1 Operational Heaters

NONE

3.3.5.2.2 Louver/Radiator Assemblies

NONE

3.3.5.2.3 Survival Heaters

CPL 565 (2/27/91)

3.3.5.2.4 Safety Heaters

Operation of the safety heaters while AMSU-B is powered on could be especially detrimental to the performance and reliability of its receivers and must be prevented. The safety heaters shall be activated only during thermal vacuum tests and when all of the following conditions exist: (a) the instrument is powered off, (b) the survival heaters are powered off; and (c) the instrument temperature falls to 6°C as indicated by thermocouple TC010 on the AMSU-B baseplate.

3.4 Environmental Interface

The instrument shall conform to Sections 3.5, 3.6, and 3.7 of the General Instrument Interface Specification, IS-3267415.

3.4.1 Magnetic Characteristics

The magnetic characteristics of the instrument shall be in conformance with Section 3.5 of the General Instrument Interface Specification, IS-3267415.

The magnetic environment imposed by the spacecraft will be as specified in Section 3.5 of the General Instrument Interface Specification, IS-3267415.

3.4.2 EMI

The AMSU-B shall conform to Section 3.6 of the General Instrument Interface Specification, IS-3267415, Appendix D of the GSFC Performance Assurance Requirements (GSFC S-480-40, Revision M), and to Table 15 of this document.

3.4.3 Flight Environment

The AMSU-B shall survive the environment detailed in Appendix D of the GSFC Performance Assurance Requirements Document (GSFC S-480-40), Revision M. Exceptions or special precautions which must be taken during exposure to these environments are detailed below:

NONE

TABLE 15. RF FIELDS AT AMSU-B INSTRUMENT

Spacecraft Antenna	Instrument Antenna (v/m)	Frequency (MHz)
SBA-1	20.6	1698
SBA-2	18.4	1702.5
SBA-3	27.9	1707
SLA	19.5	1544.5
VRA	11.5	137.5/137.62
SOA(1)	8.3	1702.5
SOA(2)	7.1	2247.5
BDA	6.4	137.35/137.77

(1) Earth-facing antennule. Assumed to be co-located with the earth-facing antennule of another S-Band omni - the one for the new S-Band beacon, at an unspecified frequency. Normally only the beacon omni will radiate when AMSU is on. For both omnis radiating, assume each one produces the given field strength, and omit radiation from SBA2.

(2) Earth-facing antennule of launch/emergency omni.

(3) Field strength calculations are at the center of the instrument antenna.

3.5 Operational Requirements and Precautions

3.5.1 Storage Requirements

(1) General: The AMSU-B will be mounted and stored in its transit case.

(2) Temperature Limits: 75 ±10°F

(3) Humidity Limits: Maximum Humidity 55%

(4) Storage Pressure: The AMSU-B shall be stored in its transit case. Lockheed Martin can provide pressurized air or nitrogen periodically as required.

(5) Other: The AMSU-B shall be bench tested at least once every 9 months with the exception that it must have been tested within 6 months before being removed from storage for installation on the spacecraft.

3.5.2 Test Requirements

(1) Test Constraints:

Operation of the AMSU-B scan mechanism in air will degrade the bearing performance. The following constraints shall be adhered to for ground operations/test phases.

(a) Nitrogen Purge

During all tests that involve rotation of the scanning mechanism bearing assembly with the exception of operation under vacuum conditions ($<10^{-5}$ Torr), the scanning mechanism bearings shall be subjected to a Dry Nitrogen purge. The purge shall be for a minimum period of 15 minutes at a purge rate of 10 cubic feet/hour prior to the start of the test, followed by a constant purge rate of 5 cubic feet/hour during the operation of the mechanism.

A Nitrogen purge point is provided on the body of the drive mechanism.

(b) Mechanism Rotation

Even with a Nitrogen purge during ground operation of the scanning mechanism, the lead lubricated bearings will still wear at an increased rate (with respect to on orbit and/or vacuum operation). Hence, during all stages of ground testing (not performed under vacuum conditions), operation of the scanning mechanism shall be minimized to the fullest extent possible with a goal of maintaining, but not restricted to, a limit of 133 hours.

During all stages of ground testing the cumulative number of revolutions incurred by the scan mechanism shall be recorded.

(c) Nitrogen Purity

The Nitrogen gas used to purge the AMSU-B scan motor assembly must meet the following specification:

1. 99.998% pure.
2. Oil free.
3. Less than or equal to four (4) parts per million (ppm) of water (H_2o).
4. Less than or equal to four (4) parts per million (ppm) of oxygen (O_2).

(2) Handling: Controls and procedures shall be per the following documents (BAe supplied):

- "AMSU-B General Handling Procedure", HIR/AMS/J2346/BAe
- "Instrument Safety Requirements"
- "AMSU-B ESD Control Plan", PLN/AMS/J2949/BAe

(3) Temperature Limits: (For thermocouple TC010 on instrument baseplate)

Operating - Within Test Specification: 11°C (min.), 32.5°C (max.)
Operating - Survival: 1°C (min.) 43°C (max.)
Non-Operating (Not Powered): -25°C (min.), 47°C (max.)

(4) Cleanliness: All spacecraft tests will be performed in a Class 100,000 cleanroom environment except for acoustics, pyro shock, T-V preparations, and during transportation. For these tests the instrument vendor will provide protective covers or instructions how to bag them with a protective film.

3.5.3 Operational Requirements

3.5.3.1 Command Sequences

Command sequences for AMSU-B operations shall be as follows:

3.5.3.1.1 Initial Turn-On Sequence (In-Orbit)

1) Configure level commands in accordance with the following:

LEVEL CMD	STATUS
ch 16 on/off	off
ch 17 on/off	off
ch 18/19/20 on/off	off
Space view select (MSB) LO/HI	low
Space view select (LSB) LO/HI	low
Memory checks EN/DIS	enable

2) Send Survival Heater OFF command if Survival Heater powered.

3) Send Instrument ON command (Confirm TM-Dig-B).

4) Provided Instrument temperature is within operational constraints:

- Configure the ch 16 on/off level command to ON. (Confirm TM-Dig-B).
- Configure the ch 17 on/off level command to ON. (Confirm TM-Dig-B).
- Configure the ch 18/19/20 on/off level command to ON. (Confirm TM-Dig-B).

3.5.3.1.2 Normal Turn-On Sequence (Test)

Application of power lines: (Bench STE only)

a) 10V Interface-On
b) 28V Main Bus-On
c) 28V Pulse Bus MTR-On
d) 28V Pulse Bus HTR-On
e) 28V ATM Bus-On

Then as for 3.5.3.1.1 above:

1) Configure level commands in accordance with the following:

LEVEL CMD	STATUS
ch 16 on/off	off
ch 17 on/off	off
ch 18/19/20 on/off	off
Space view select (MSB) LO/HI	low
Space view select (LSB) LO/HI	low
Memory checks EN/DIS	enable

2) Send Survival Heater OFF command if Survival Heater powered.

3) Send Instrument ON command (Confirm TM-Dig-B).

4) Provided Instrument temperature is within operational constraints:

- Configure the ch 16 on/off level command to ON. (Confirm TM-Dig-B).
- Configure the ch 17 on/off level command to ON. (Confirm TM-Dig-B).
- Configure the ch 18/19/20 on/off level command to ON. (Confirm TM-Dig-B).

3.5.3.1.3 Turn-Off Sequence

1) Configure the CH 18/19/20 On/Off level command to OFF.
2) Configure the CH 17 On/Off level command to OFF.
3) Configure the CH 16 On/Off level command to OFF.
4) Send Park in Target command and confirm this state achieved.
5) Send Instrument Power OFF command.
6) Send Survival Heater ON command if necessary for low temperature survival.

3.5.3.1.4 Safestate Sequence

1) Park antenna in internal target view position.
2) Turn instrument power off.
3) Survival Heater ON command-flight load package ONLY.

3.5.3.2 Turn-On Constraints

1) Pressure. When the instrument is not in vacuum Paragraph 3.5.2(1) shall apply.
2) Solar and Albedo: TBS-BAe
3) Magnetic Fields. Magnetic fields no greater than those specified in the GIIS IS 3267415, shall be applied. The AMSU-B shall not be subjected to de-gaussing.
4) Other: Survival Heaters shall not be on when the instrument is powered.

3.5.3.3 Initial In Orbit Turn-On Constraints

- Section 3.5.3.1.1 shall be applicable in full.
- Survival Heaters shall not be on when the instrument is powered.

3.5.3.4 AIP Switchover

If AIP switch over occurs and the redundant side starts up with a random phase 8-second sync with respect to the original sync, the AMSU-B will respond in one of two ways dependent on the status of the Memory Checks Enable/Disable command:

a) Memory Checks Enabled (Normal Operational Status). The AMSU-B instrument will autonomously re-initiate and will re-synchronize the instrument to the new 8-second sync.

b) Memory Check Disabled. The AMSU-B will not re-synchronize the scan profile to the new 8-second sync and as a result the scan synchronization flag in the serial digital telemetry A01 word will indicate an error. Recovery of the instrument to normal synchronous operation will require ground command to re-initiate the instrument.

3.5.3.5 Launch Configuration

Instrument power shall be off and the antenna in stow (internal) position.

4.0 INSTRUMENT INTEGRATION, TEST AND OPERATING REQUIREMENTS AND CONSTRAINTS

4.1 Test Equipment and Service

4.1.1 Equipment to be Supplied by Instrument Contractor to Lockheed Martin

The following is an inventory of the equipment that shall be supplied by the instrument contractor:

(a) Bench Check Unit (BCU) - This unit shall be capable of operating the instrument in all its operating modes.

(b) Contamination Covers - This cover(s) shall be used to minimize the accumulation of contamination on optical surfaces both during the bench check testing and while the instrument is on the spacecraft.

(c) Handling Fixture - The handling fixture shall be used to lift the instrument from its shipping container and shall also be used to handle the instrument during bench operations. It shall be removed from the instrument prior to installation of the instrument on the spacecraft unless the handling fixture is part of the lifting fixture.

(d) Thermal Blankets - The thermal blankets shall be as shown on the detailed drawings, TBD. These blankets shall be shipped with each instrument.

(e) Connector Savers - A set of connector savers shall be provided with each instrument. These connector savers will remain on the instrument until it is integrated on the spacecraft and will not be removed until after the IPF is performed.

(f) Optical Alignment Equipment - A permanent alignment mirror(s) shall be provided.

(g) Thermal Vacuum Targets - TBS

(h) Cables - The cables required to connect the BCU to the instrument shall be supplied.

(i) Lifting Fixture - This fixture shall attach to the instrument and shall allow the instrument to be mounted to the spacecraft when the spacecraft is in a vertical position. The fixture shall have provisions for lifting with a crane.

4.1.1.1 Bench Check Unit

The Bench Check Unit (BCU) shall consist of:

BTE #2, serial no. CN01, Software #54.

4.1.1.2 Thermal Vacuum Target

TVT/MO/01

4.1.1.3 Target Controller

TC/MO/01

4.1.1.4 Handling Fixture

There is no handling fixture, only a lifting fixture (see Para. 4.1.1.7).

4.1.1.5 Thermal Blanket

The thermal blankets, which must be attached to the instrument after it is mounted on the spacecraft, shall be detailed in drawing #PLN/AMS/J3641/Bae. AM-orbit and PM-orbit specific MLI blanket configurations shall be as described in PLN/AMS/J3641/Bae and are shown in Figure 14A and Figure 14B. Orbital configuration of AMSU-B MLI blankets for each spacecraft shall be as specified by GSFC direction. Following attachment, the blankets shall be electrically grounded to the instrument as shown in Figure 14C.

4.1.1.6 Lifting Fixture

The lifting fixture shall be as shown on Figure 1, page 8 of specification #HPR/AMS/J3805/BAe, Issue 2. The operating instructions for use of the fixture shall be given in specification #HPR/AMS/J3805/BAe, Issue 2.

4.1.1.7 SEPET Target

ABK/AMB/101

4.1.1.8 Target Controller

JPL 1006 3838

4.1.2 Services Provided by Instrument Contractor at Lockheed Martin

4.1.2.1 Bench Test

The Bench Test of the first Flight Model shall be performed by instrument contractor personnel. During the performance of this test the instrument contractor shall instruct the assisting Lockheed Martin personnel in the use of the BCU and the performance of the bench test.

4.1.2.2 Data Analysis

There are no provisions to send instrument contractor personnel to Lockheed Martin to review data other than informally or in a trouble-shooting mode as directed by NASA. Instrument contractor personnel shall be present at Lockheed Martin during initial integration of the Flight Model and for selected system tests thereafter as directed by NASA.

4.1.2.3 Troubleshooting

Instrument Contractor and GSFC personnel shall be available at Lockheed Martin to assist in troubleshooting as directed by NASA.

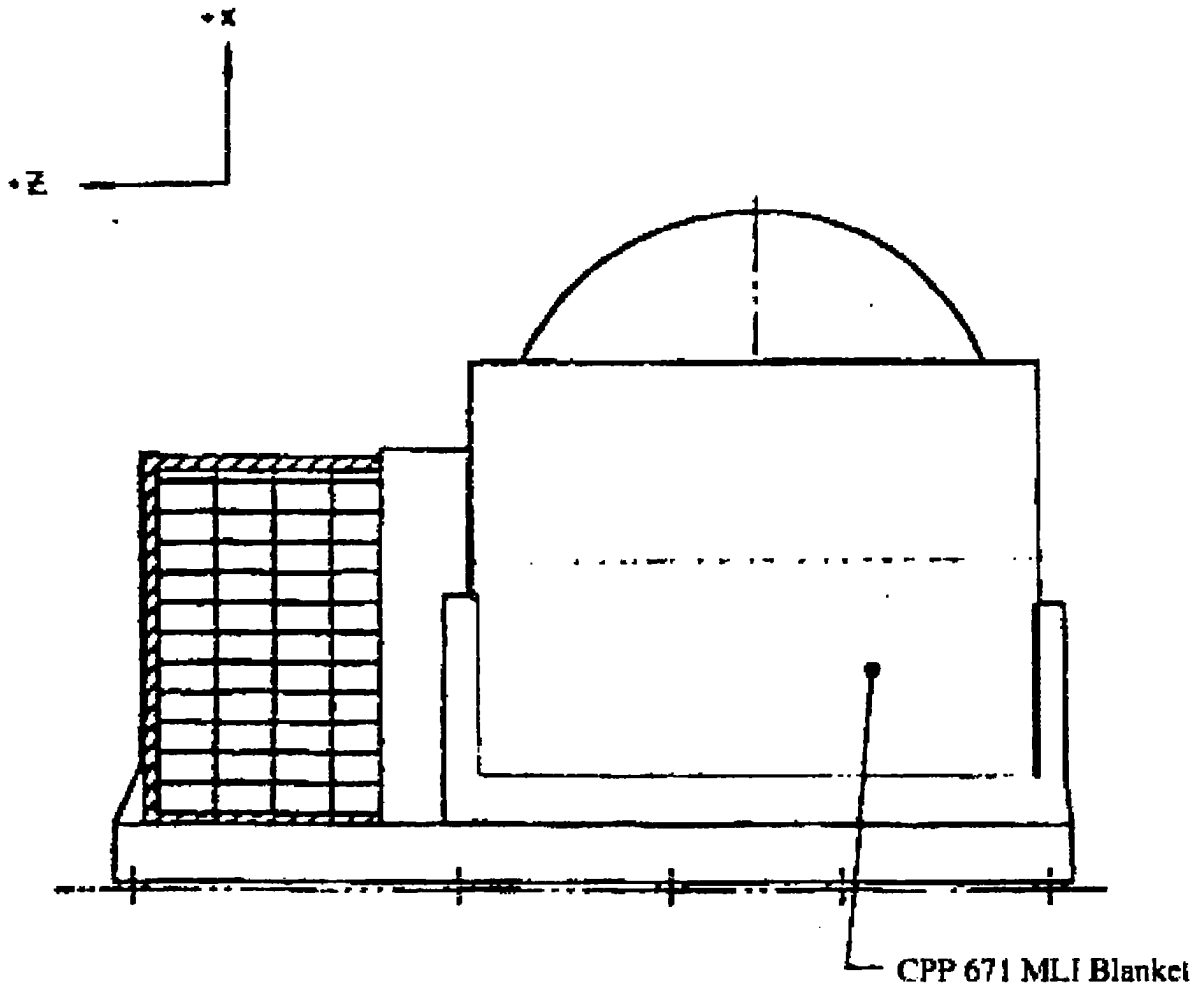
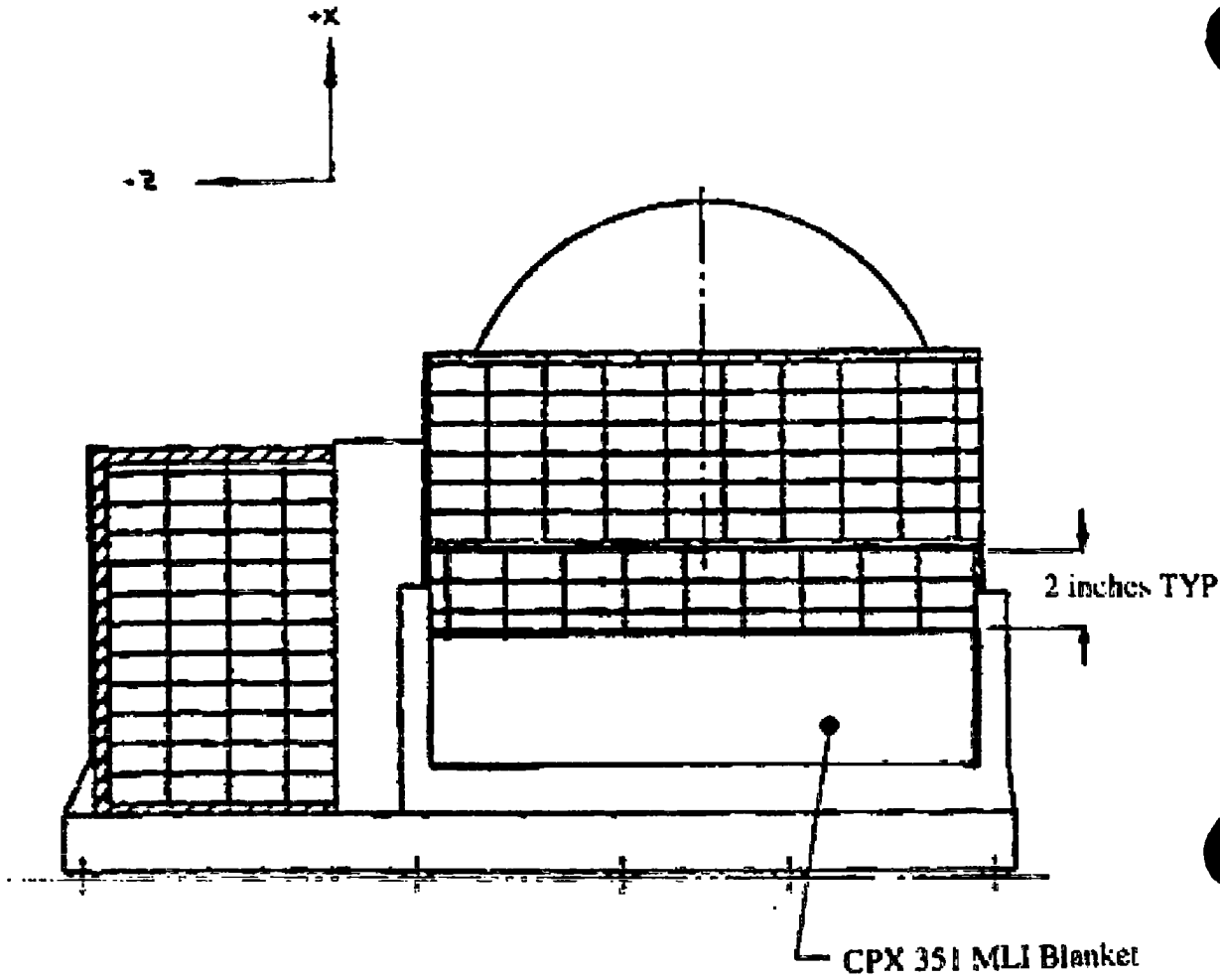


Figure 14A. AMSU-B MLI Blanket Configuration Trim for AM-Orbit



Installation of CPX 351 MLI blanket
(Reference: PLN/AMSU364 I/Ba2)

Figure 14B. AMSU-B MLI Blanket Configuration Trim for PM-Orbit

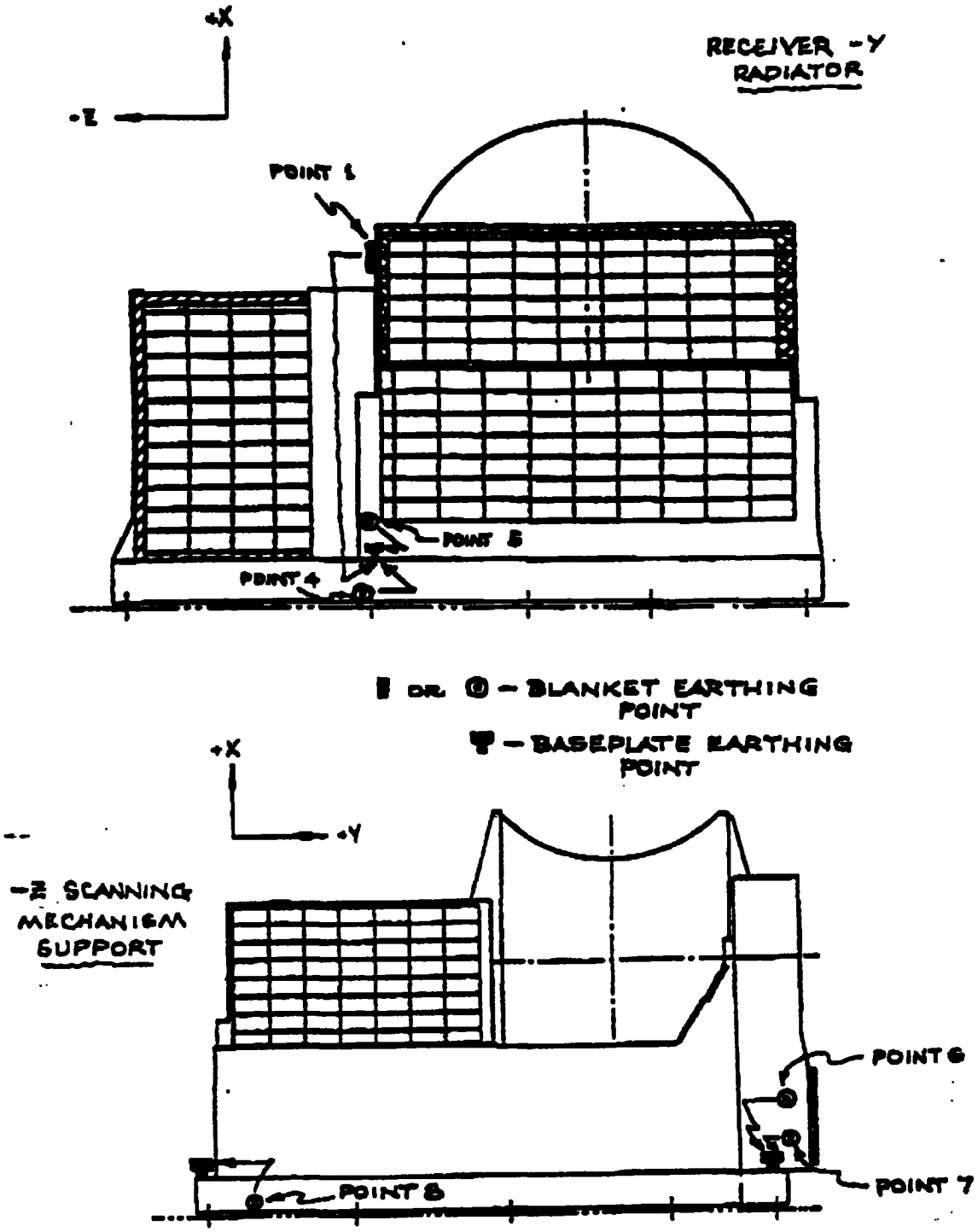
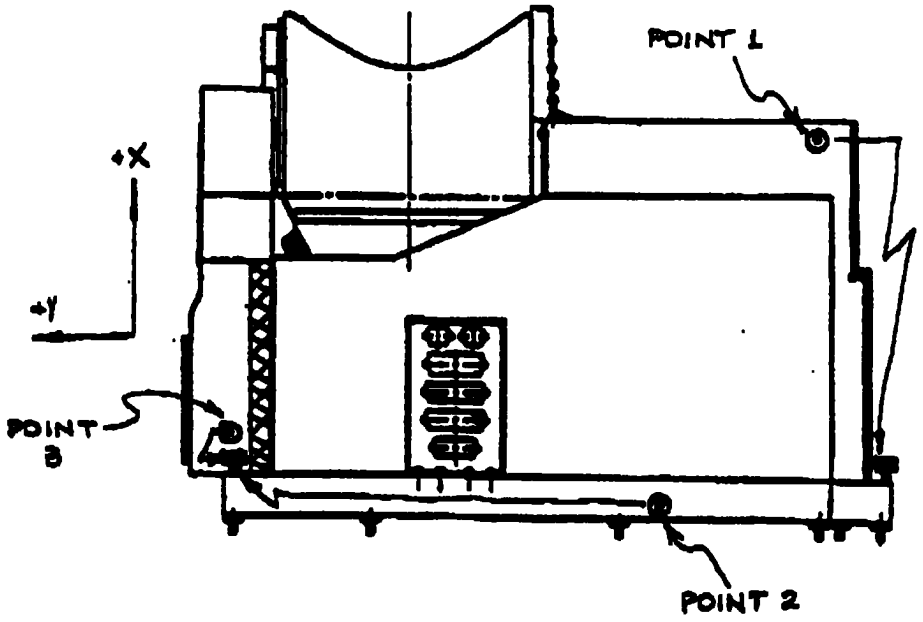


Figure 14C. AMSU-B Thermal Blanket Grounding (Sheet 1 of 2)



PSU +Y FACE

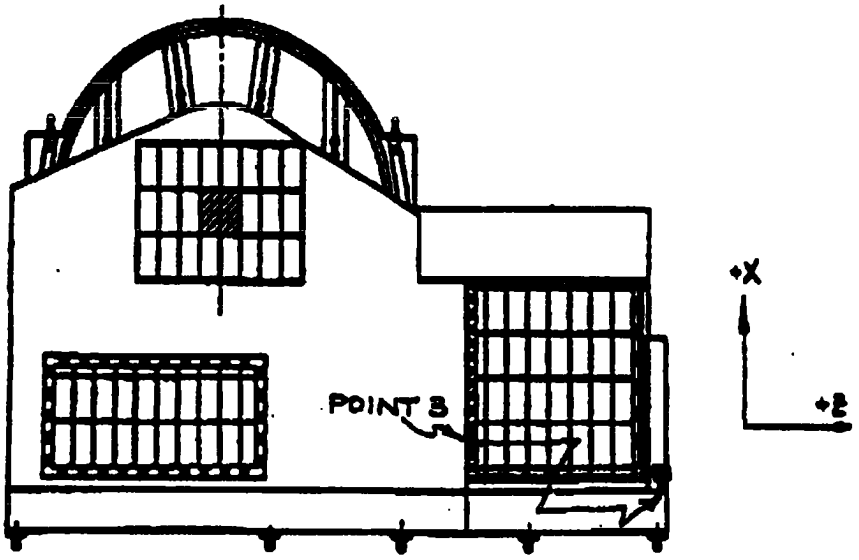


Figure 14C. AMSU-B Thermal Blanket Grounding (Sheet 2 of 2)

4.1.2.4 Warranty

There are no warranty provisions between the Met Office and Lockheed Martin. If repair of an AMSU-B is necessary NASA will arrange with the Met Office to have it completed.

If the AMSU-B must be shipped back to the vendor, Lockheed Martin will assure the unit is packed in the original shipping container.

Lockheed Martin will arrange all transportation, at the direction of NASA, and intermediate storage to conform to the storage environmental limits in this specification. If the instrument is to be shipped by air, Lockheed Martin will escort the shipment to the air terminal.

The Lockheed Martin transportation office will make these arrangements based upon the local climate at the time of shipment. If for some reason these environmental limits cannot be assured, the shipment will be held, and NASA will be notified.

4.1.2.5 Equipment Maintenance to be Supplied by Instrument Contractor

The instrument contractor shall be responsible for maintenance of all test equipment delivered to Lockheed Martin until the end of the contract, except for any designated, commercial test instruments which will be maintained by Lockheed Martin.

Maintenance or repairs can be done at Lockheed Martin, or, in the event any equipment needs to be shipped to the instrument contractor, Lockheed Martin will accept responsibility for all transportation arrangements as defined in paragraph 4.1.2.4 of this document.

4.1.3 Software to be Supplied by the Instrument Contractor to Lockheed Martin

4.1.3.1 Bench Test Procedure

The Bench Test Procedure will be supplied to Lockheed Martin concurrent with delivery of the BCU. The preliminary versions of this procedure will be submitted to Lockheed Martin as generated.

4.1.3.2 GSE Operations Manuals and Procedures

The ancillary manuals and procedures necessary for use of the various test equipment will be shipped to Lockheed Martin concurrent with delivery of the BCU; preliminary version of these documents will be submitted as generated. The documents covered by this paragraph are: TBS.

4.1.3.3 Data Book, Specification Verification and Calibration

A data book shall be supplied with each instrument. The alignment portion shall contain:

(a) Instrument Alignment to its mounting surface;
(b) Optical Fields of View;
(c) Size, Weight and Center of Gravity of each module.

The calibration data shall comprise:

(a) Conversion equations for Digital A telemetry
(b) Conversion Equations for Analog telemetry
(c) TBS

4.1.3.4 Handling Procedures

The Instrument Handling Procedure, document No. TBS, will be delivered with the first Flight Model. Preliminary versions of this document will be submitted to Lockheed Martin as generated.

4.1.4 Equipment and Services to be Supplied by Lockheed Martin for Direct Instrument Support

4.1.4.1 Lockheed Martin Supplied Equipment and Services

a. Power Input at Test Location

(1) 115 Vac, 60 Hz, Single Phase, 20 Amp. Service for BCU

b. Floor Space to Accommodate the Following (GFE) Equipment:

	Size (Inches)	Weight (Pounds)
1) Bench Check Unit TBS		
2) Interface Test Box - Cables		

c. Test Area

The contractor shall provide a test area for the AMSU-B which meets the following environmental requirements:

1. Cleanliness: - Class 100,000
2. Temperature Limits: - 65°-85°F (18 - 29°C)
3. Relative Humidity: - 55 Percent Max.

d. Standard Test Equipment

The standard test equipment shall be available at Lockheed Martin to set up and troubleshoot the BCU and to use during the bench test and post storage tests.

4.1.4.2 Lockheed Martin Supplied Labor for Testing at the Instrument Level

a. First Flight Model: - Lockheed Martin will assist the Instrument contractor personnel in performing the Bench Test.

b. Flight Models and Post Storage Testing: - Lockheed Martin will perform the Bench Tests. The bench test will be performed at nine (9) month intervals on instruments not mounted on a spacecraft.

4.1.5 Test Access to the AMSU-B

4.1.5.1 During Bench Checkout

All electrical interfaces to the instrument will be through the AMSU-B/Spacecraft connectors. There may be test connectors on the AMSU-B but these are to be used only during the Bench Checkout, access to them will not normally be required.

4.1.5.2 During Satellite Level Tests

Access will be required to the instrument during the spacecraft level testing to remove the protective cover over the antennae. The dust cover will be kept on the scan cavity except during (1) operational test, (2) RFI test, (3) vibration and (4) the thermal vacuum test.

4.1.5.3 Access for Inspecting Scan Antennae and Reflectors

Access to the instrument will be required just before enclosing the spacecraft with the shroud for the purpose of inspecting the antenna and reflectors.

4.1.5.4 During Launch Pad Testing (Fairing On)

There shall be no need for visual inspection of the instrument on the Launch pad. There will be no targets mounted in the fairing for the instrument use.

4.2 Acceptance Test Performed at the Instrument Contractor

The tests that are to be performed by the Instrument Contractors are defined in UK Met Office Specification for AMSU-B.

4.3 Testing at Lockheed Martin

The objective of testing the instrument at Lockheed Martin is to assure compatibility of the instrument with the spacecraft and to demonstrate that the instrument meets its specified characteristics. The test program is divided into test performed on the instrument only, i.e., the Instrument Evaluation Tests; and on the instrument as part of the spacecraft system, i.e., the System Evaluation Tests and the Environmental Tests. The test flow of this is given in Figure 15. Test failures related to the instrument will be documented by a Test Discrepancy Report per GE operating instruction PAP E8.3 as specified in the Quality Assurance Plan, 3267412.

4.3.1 Instrument Evaluation Tests

The objective of the Instrument Evaluation Tests is to demonstrate that the instrument has the same characteristics at Lockheed Martin as it did when tested at the instrument contractor's plant before shipment. At the completion of the Evaluation Tests the instrument is either put on the spacecraft or is put into storage to wait for later mounting. This evaluation test is divided into Receiving, Incoming Inspection Mechanical, and Incoming Inspection Electrical. Storage and storage retesting are also considered part of the Instrument Evaluation Tests.

4.3.1.1 Receiving

The objective of the receiving tests and inspection is to detect any gross damage during shipping and to verify delivery of documentation supplied with the instrument. The transit package will not be opened during receiving inspection. Alignment and calibration and other instrument related data will be reviewed by Lockheed Martin Systems Engineering.

4.3.1.2 Incoming Inspection - Mechanical

The objective of the mechanical incoming inspection is to check for physical damage to the instrument and to document its condition as received at Lockheed Martin. The state of the shock indicators will be determined and recorded. The instrument will be weighed. This weight will be used in establishing the full spacecraft weight. The mechanical inspection which requires the removal of the scan cavity dust cover will be done in an environment which meets the Class 10,000 requirements.

4.3.1.3 Degaussing

The AMSU-B will not be degaussed.

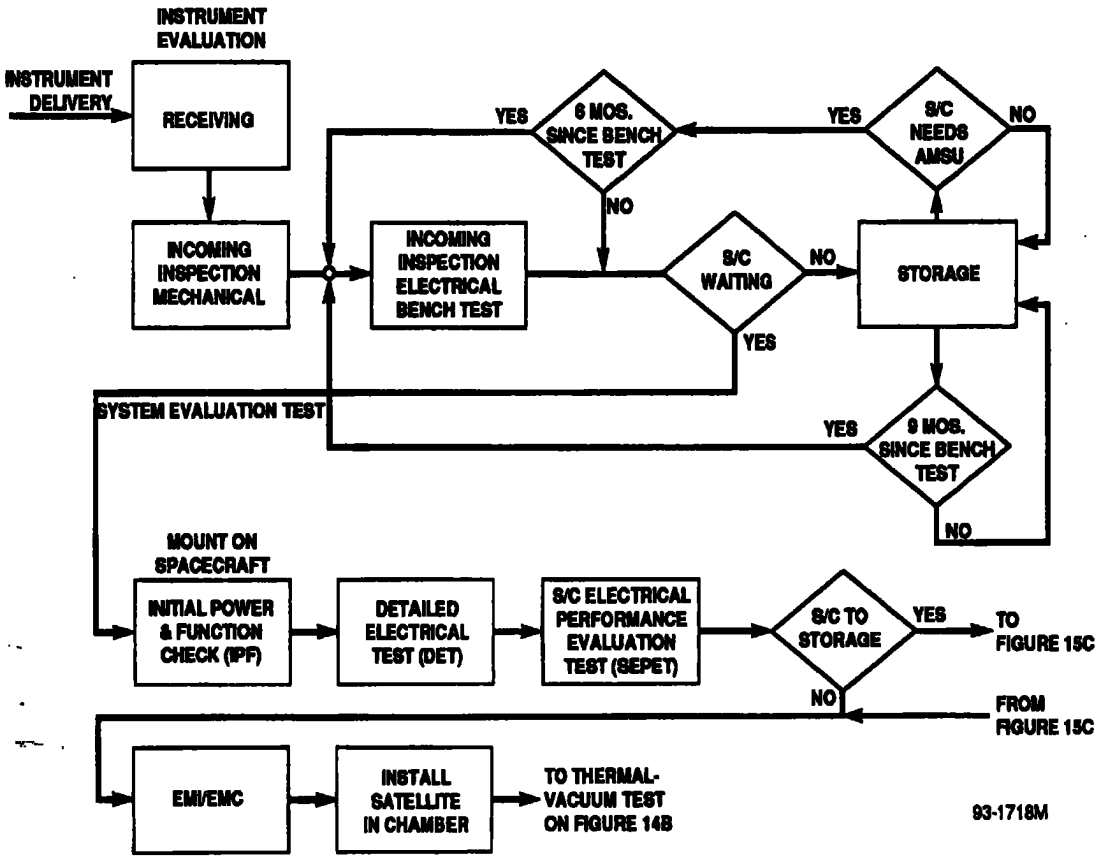


Figure 15A. AMSU-B Testing at Lockheed Martin

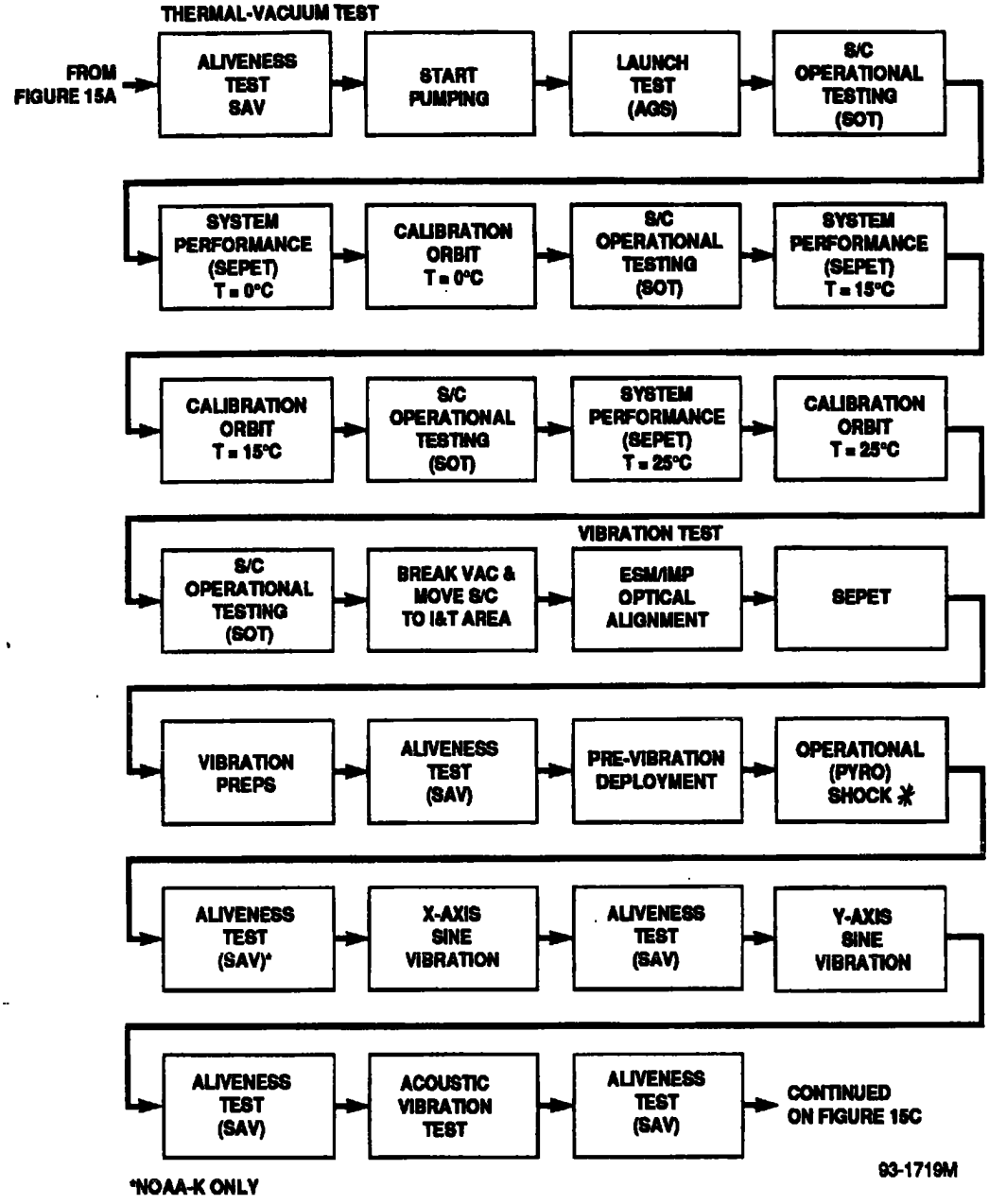


Figure 15B. AMSU-B Testing at Lockheed Martin (Continued)

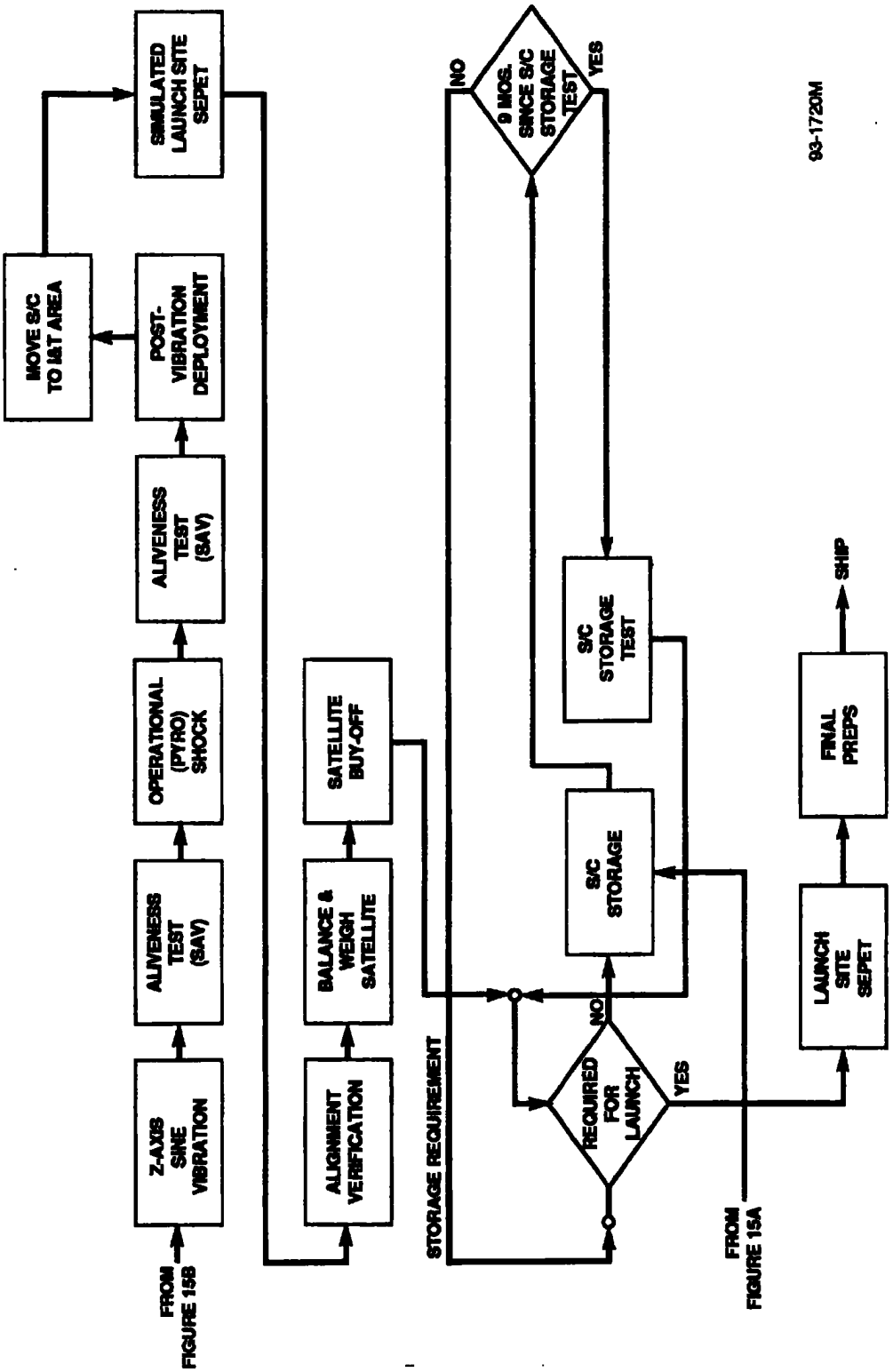


Figure 15C. AMSU-B Testing at Lockheed Martin (Continued)

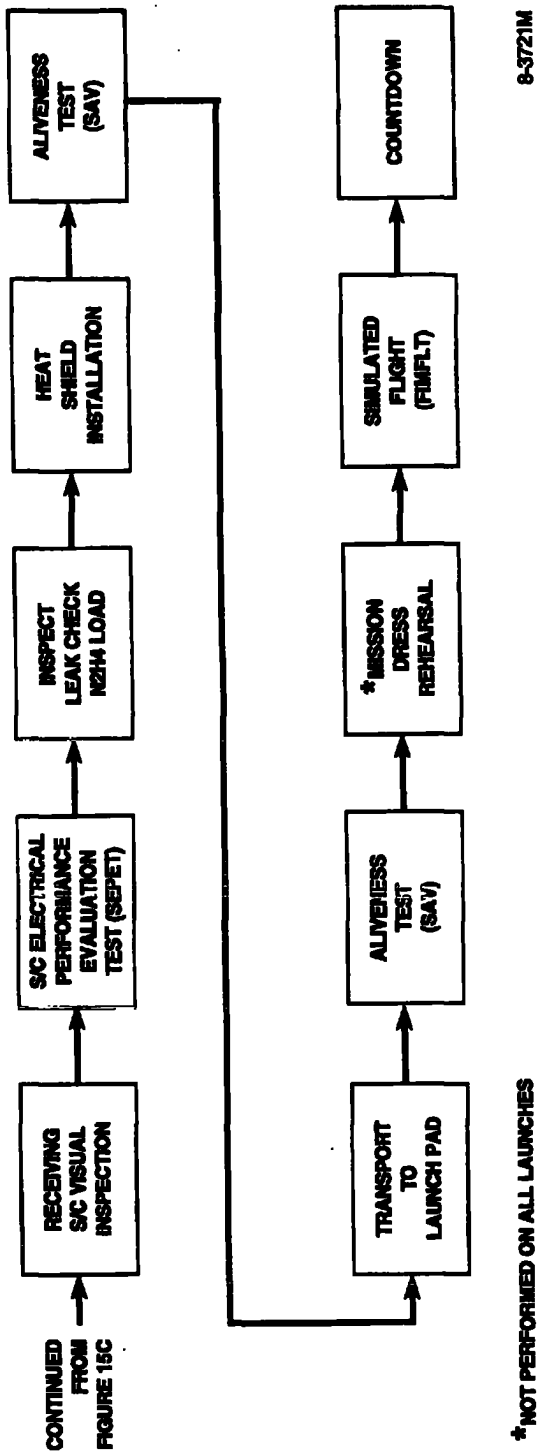


Figure 15D. AMSU-B Testing at WTR

4.3.1.4 Incoming Inspection - Electrical (Bench Test)

The Bench Test will be performed to ensure that the electrical and functional characteristics have not changed as a result of shipping. The Bench Check Unit (BCU) will be separately tested before being connected to an instrument.

4.3.1.5 Storage and Storage Testing

The AMSU-B will be stored following the Incoming Electrical Inspection if not integrated on a waiting spacecraft.

The purpose of Storage testing is to assure that the instrument has not failed during storage. Instruments in storage shall be tested nine (9) months after the last bench test and every nine months thereafter. These periodic tests are comprised of a Bench Test.

Instruments which have been in storage more than six (6) months will undergo a Bench Test before installation on the spacecraft. The requirements are given in Paragraph 3.5.1 of this specification.

4.3.1.6 Instrument Test Matrix

The instrument level and spacecraft level test matrix is given in Tables 16A and 16B.

4.3.2 Mounting to Spacecraft

When the AMSU-B is to be mounted on the spacecraft, it will be placed on a clean bench and the handling fixture will be removed. The lifting fixture, after having been cleaned, will be attached to the instrument. The scan cavity dust covers will be checked for proper installation. The AMSU-B will then be installed on the spacecraft.

4.3.3 System Evaluation Test

The objectives of the System Evaluation Test are to integrate the instrument to the spacecraft system and to assure that the AMSU-B meets all interface requirements.

The System Evaluation Test is divided into the Initial Power and Functional Check (IPF); the Detailed Electrical Test (DET); and the Spacecraft Electrical Performance Evaluation Test (SEPET).

For all tests the instrument is mounted on the spacecraft and the test data can be processed by the ATNAGE.

TABLE 16A. AMSU-B TEST MATRIX

TEST	BENCH TEST	SYSTEM EVALUATION IPF	DET	SEPET	ALIVE-NESS	THERMAL VACUUM AGS	SEPET	CAL CHECK
REFERENCE PARAGRAPH	4.3.1 .4	4.3.3 .1	4.3.3 .2	4.3.3 .3	4.3.4 .1		4.3.4.2	
POWER STATUS S/C PWR OFF	X							
S/C ON, AMSU-B OFF						X		
AMSU-B ON		X	X	X	X		X	
1. Ground Resistance Measurements		X						
2. Harness Verification		X						
3. Power Measurements	X	X						
4. Input Signal Level Measurement	X							
5. Command/Mode Verification	X		X	X	X		X	
6. Output Signal Level Measurement	X		X					
7. Digital "A" TM Format Verification	X		X	X	X		X	
8. Limit Check Digital "A" TM	X		X	X	X		X	
9. Limit Check Analog Telemetry	X	X	X	X	X	X	X	

TABLE 16B. AMSU-B TEST MATRIX

TEST	ENVIRONMENTAL TESTS				
	OPTICAL ALIGNMENT	SINE VIBRATION	ACOUSTIC VIBRATION	POST-VIB DEPLOYMENT	FINAL SEPET
REFERENCE PARAGRAPH	4.3.4.3	4.3.4.4	4.3.4.5	4.3.4.6	4.3.4.7
POWER STATUS S/C PWR OFF	X				
S/C ON, AMSU-B OFF		X	X	X	
AMSU-B ON					
1. Ground Resistance Measurements					
2. Harness Verification					
3. Power Measure					
4. Input Signal Level Measurement					
5. Command/Mode Verification					X
6. Output Signal Level Measurement					
7. Digital "A" TM Format Verification				X	
8. Limit Check Digital "A" TM				X	
9. Limit Check Analog Telemetry	X	X	X	X	

4.3.3.1 Initial Power and Functional Checks (IPF)

The objectives of the Initial Power and Functional Checks are (1) to provide an orderly method of verifying that application of power to the AMSU-B will not damage it or previously integrated subsystems; and (2) to verify that, after mating, the correct electrical interface has been established.

Correct operation of the instrument will be established by the use of breakout boxes and probes as required. Input signal voltages and power level measurements will be made on the spacecraft harness prior to mating with the AMSU-B. Breakout boxes and/or probes may be used to expedite the measurement of signal levels and loading in all operational modes. However, the use of any breakout box or probe at the AMSU-B/spacecraft interface will be subject to the following provisions: (1) all voltage taps will be protected against damage by external shorts pin-to-pin and pin-to-ground and no breakout box will contain more than one AMSU-B connector; and (2) all power level or current measurements will be made using clip-on induction probes and extender harnessing. The parameters to be tested during the IPF are the following:

(a) Case Grounding - Verify case ground is firmly attached to the spacecraft ground.

(b) Harness verification - These measurements verify that electrical inputs to the instrument are on the correct pins. The presence of power on input pins, both full time and switched, is verified. Command functions on assigned lines are verified. Clock signals on assigned lines are verified. This harness verification is done prior to the initial instrument installation. If the AMSU-B is exchanged the harness verification will not be repeated. Resistance of all AMSU-B S/C Harness ground return lines will be measured.

(c) Instrument ground isolation - All power supply and signal grounds will be checked for isolation from the spacecraft ground before the S/C harness is connected.

4.3.3.2 Detail Electrical Test (DET)

The purpose of the Detailed Electrical Test is to demonstrate that the correct interface exists between the instrument and the spacecraft. The correct interface may be demonstrated by using breakout boxes (subject to the constraints of Paragraph 4.3.3.1) to measure signal levels at the interface. The DET will include a functional checkout in which the instrument is commanded into each of its states to verify correct electrical and mechanical response. The parameters to be tested during the DET will be the following:

(a) Input Signal Level Measurement - The measurements of the clock signal and command signal levels are made to ensure that the instrument is supplied the correct amplitude signal and that the input of the instrument does not load down the driving circuit.

(b) Command/Mode Verification - Verification of the correct response to each command will be measured by the mechanical response and electrical output. Status verification will also be performed using Digital A Status Monitors and Digital B telemetry.

(c) Output Signal Level Measurements (Except for Radiometric Data) - The measurement of the output signal levels will be made to ensure that the instrument is supplying the correct levels to the spacecraft and the spacecraft does not incorrectly load the circuits. The measurement will also verify that signals exist at each of the outputs of the Digital B Telemetry and Analog Telemetry which corresponds to the operating function.

(d) Scan Operation Verification - The correct scan operation will be verified using the information output contained in the Digital A data stream.

(e) Digital A Data Format Verification - Verification of the Scientific Data Format will be demonstrated by the ability of the ATNAGE to decode and display all of the SBUV words contained in the Digital A data stream. In addition this test will validate the data base being used with the instrument.

(f) Analog Telemetry Verification - Verification of the operation of each of the Analog Telemetry points will be demonstrated by ATNAGE limit checking. This test will also verify the validity of the data base.

4.3.3.3 Spacecraft Electrical Performance Evaluation Test (SEPET)

The SEPET has two basic objectives: (1) to demonstrate by measurement that the system meets all specification criteria; (2) to compare the data with previous measurements or establish the basis for future comparison. The SEPET is the most comprehensive ambient electrical test of the entire spacecraft.

The SEPET will be performed in a room temperature environment at atmospheric pressure.

(a) Command/Mode Verification - Verification of correct response to each command will be measured by the mechanical response and electrical output. Status verification will also be performed using telemetry.

(b) Limit Check - A number of Digital A telemetry words will be continuously limit checked in real time.

(c) Limit Check Analog Telemetry - All analog telemetry will be limit checked.

(d) Scan Verification - This test will verify the correct operation of the scan motor. The AMSU-B scan verification shall be conducted in accordance with the test constraints identified in Section 3.5.2.1.

(e) Gain Determination - The temperatures of an external hot target and the AMSU-B blackbody are to be taken over forty-five (45) scans. The external target face is to be positioned at a distance of 152.4 mm (6 inches) from the surface of the antenna shroud with the line centers of the target face and antenna coincident within ±5 mm (0.2 inch). The target shall be operated at a temperature of 55±1 degrees C (maximum allowable operation is 60 degrees C). This gain test is performed only during the pre-ship and WTR launch-site SEPETs.

4.3.4 Satellite Environment Test

4.3.4.1 Aliveness Test

The aliveness test verifies that the instrument is correctly set up to enter a specific environment or has successfully passed the environmental exposure. The evaluation is accomplished by commanding the instrument through its orbital modes and status checking the data.

4.3.4.2 Thermal-Vacuum Tests

The purpose of the Thermal-Vacuum Test is to demonstrate the successful performance of the integrated satellite at temperature extremes in a vacuum environment.

The test will be performed with the spacecraft in the 24 foot or 35 foot vacuum chamber at GE ASD. The pressure will be less than 10^{-5} TORR and the walls of the chamber maintained at -65°C.

Two metal shields with 220-watt (maximum) heaters attached shall be used to maintain instrument operational temperatures. One shield shall be located 94 ±15 mm from the base of the AMSU-B test target, with the test target base located closer to the instrument than the shield. The second shield shall be located coplanar with the face of the target and off to one side of the target with thermal isolation between. A voltage supply and temperature controller shall be employed to operate the heaters and monitor and maintain the AMSU-B temperature within the operating range of +16°C to +36°C during all thermal vacuum tests. Instrument temperature is that indicated by the channel 16 mixer temperature sensor.

During the Thermal-Vacuum operation, the tests will be divided into AGS (launch simulation), Aliveness, System Performance, and Calibration check orbits. The functions to be tested in each of these tests are shown in Table 14. Details of the tests are given below:

(a) AGS - A simulated launch test will be performed following pumpdown. The AMSU-B will be in its Launch mode.

(b) T-V SEPET - The test has similar objectives to the SEPET performed in the ambient condition.

(c) Calibration Check Orbits - The AMSU-B will be in a normal test mode. The flow of LN_2 to the AMSU-B target will be stopped for the cold and nominal tests and the target will be allowed to drift.

At the hot test the target temperature will be stabilized at LN_2 temperature and at 320 ±10K, in that order, and measurements will be taken for 20 minutes each with the instrument scanning. Following these tests, flow of LN_2 to the target will be restored for the next cold plateau. NOTE: The target is capable of being simultaneously cold and heated by the target controller.

(d) Transition Test - There will be no instrument testing during the time spacecraft temperatures are adjusted from one plateau to the next.

However, the normal status monitoring and data processing will be done during the period of temperature transition.

4.3.4.3 Optical Alignment

The purpose of this test is to determine the field-of-view of the instrument with respect to the satellite primary reference, the Earth Sensor Assembly (ESA). The measurement made during this test will be to determine the differences in pointing direction of the surfaces of an optical mirror(s) mounted on the instrument and the axes defined by mirrors on the AMSU-A1. The instrument will be mounted so as to meet the placement requirement of ±0.05 degrees in the Y- and Z-axis relative to AMSU-A1. This measured difference will be added to vendor supplied data which references the fields-of-view and axis to the instrument mounted cube coordinates.

4.3.4.4 Sine Vibration in X, Y, and Z Axes

The purpose of the sine vibration is to demonstrate the adequacy of the integrated spacecraft structure design. Results of the test will be used to verify the major critical resonances and the adequacy of the individual components to withstand vibration in each of three orthogonal axes. The spacecraft will be vibrated in an all up flight configuration.

The AMSU-B will be in its launch configuration. Some limited analog telemetry will be on during vibration. The scan cavity dust covers will be removed for this test.

Between each axis of vibration the instrument will be inspected. An aliveness check will also be performed between vibration axes as shown in the flow of testing at Lockheed Martin, Figure 14.

4.3.4.5 Acoustic Vibration

The purpose of the acoustic vibration test will be to demonstrate that acoustically generated noise levels more severe than those expected during launch will not adversely affect or damage the spacecraft structure or the payload instruments.

4.3.4.6 Post-Vibration Deployment Test

The instrument will be subjected to vibration as the result of deployment of some satellite equipment. The deployment tests have four (4) parts, (1) boom deployment, (2) cant deployment, (3) solar array deployment, and (4) antenna deployment.

The instrument will be in the Launch mode for these tests.

4.3.4.7 Final Electrical Check

The final electrical check will be a "Launch Site SEPET". This will be identical to the ambient SEPET.

5. NOTES

5.1 Waivers

The following waivers to the General Instrument Interface Specification (IS-2280259) have been granted for the AMSU-B.

Waiver	Description	Date of Approval
CCR 1356A	Waiver to Paragraph 3.6.1.4.2 of IS-3267415, and GSFC 5-480-25.1 Paragraphs 3.6.1.5 (j), 3.6.1.5 (n), and 3.6.1.5 (r); Performance Specification for the NOAA-K, L, M, N, and N' Satellites due to spurious EMI emissions in the SARR frequency bands from FM1.	10-2-95
CCR 1415	Waiver to Paragraph 3.1.3.2.3 of the AMSU-B UIIS (IS-2613442) for FM1 due to LMMS TDR #K0027 report of excessive ripple on the +28V Main Bus.	7-30-96
CCR 1461	Waiver to Paragraph 3.1.3.2.3 of the AMSU-B UIIS (IS-2613442) for FM2 due to LMMS TDR #L0144 report of excessive ripple on the +28V Main Bus.	3-4-97
CCR 1637	Waiver to Paragraph 3.1.3.2.3 of the AMSU-B UIIS (IS-2613442) for FM3 due to LMMS DR# W24267 report of excessive ripple on the +28V Main Bus.	3-20-00

APPENDIX A

REQUIREMENT DATES FOR AMSU-B INSTRUMENT DATA

		CODR	PDR	CDR
2.1.2	Instrument Contractor Originated Documents			
	Thermal Interface Control Drawing		X(P)	X(F)
	Outline Interface Control Drawing (Mechanical)		X	X
	Electrical Interface Control Drawing			X
	Top Assembly Drawing		X	X
	Bench Check Test Procedure Delivery of Inst.			
	Bench Check Unit Operation Delivery of BCU			
	Instrument Handling Procedure			X
	Spec Verification and Calib. Data Book Delivery of Inst.			
	Reduce Thermal Model		X	
3.1	Electrical ICD (Logic Diags.)			X
3.1.2.3	Connector Mounting Hardware	X		
3.1.2.4	Connector Keying Requirements		X	
3.1.2.6	Pin Designations Intra-Instrument		X	
3.1.3.2.1	Power Dissipation (Table 4)		X	
3.1.3.2.3	Load Current Ripple (Fig. 2)			X
3.1.3.2.4	Transient Loads (Fig. 4)			X
3.1.3.2.5	DC/DC Converter Frequency	X		
3.1.3.4.1	Power Dissipation			X
3.1.3.4.3	Transient Loads (Fig. 7)		X	
3.1.3.5.1	Power Dissipation			X
3.1.3.5.3	Transient Loads (Fig. 8)		X	
3.1.4.2	Synchronization Signals		X	
3.1.4.2	Commands (Table 7)		X	
3.1.5.2.1	General Requirements		X	X
3.1.5.2.2	Operating Modes		X	

NOTE: Where two X's appear for any item, the first X is the date by which preliminary data is required.

APPENDIX A (Continued)

REQUIREMENT DATES FOR AMSU-B INSTRUMENT DATA

		CODR	PDR	CDR
3.1.5.3.2	Digital "B" Telemetry Points (Table 10)		X	
3.1.5.4.2	Analog Telemetry Points (Table 11)		X	
3.1.6	Operations		X	
3.1.7.1	Input Test Points		X	
3.1.7.2	Output Test Points		X	
3.2.1.1	Dimensions		X	
3.2.1.3	Moments of Inertia			X
3.2.1.5	Center of Gravity			X
3.2.2.1	Instrument Mounting Surface	X		
3.2.3.1	Caging		X	
3.2.5.1	Reference Surfaces		X	
3.2.5.2	Alignment Tools		X	
3.2.6.1	Accessibility			X
3.2.6.2	Installation Requirements			X
3.2.6.4	Precautions			X
3.2.7	Inst. Material and Finishes		X	X
3.2.8	Spacecraft Harness Clamp Requirements		X	
3.3.3	Temperature Design Limits		X	
3.3.4.1	Finishes		X	
3.3.4.2	Insulation Blankets		X	

REQUIREMENT DATES FOR AMSU-B INSTRUMENT DATA

		CODR	PDR	CDR
3.3.5	Instrument Thermal Control Components		X	
3.4.1	Magnetic Characteristics			X
3.4.3	Flight Environment			X
3.5.1	Storage Requirement (Temp.)		X	
3.5.2	Test Requirements			X
3.5.3.1	Command Sequences			X
3.5.3.2	Turn-On Constraints			X
3.5.3.3	Initial Turn-On Constraints			X
4.0	Instrument Integration, Test and Operating Requirements & Constraints			X
5.1	Waivers*			

* As necessary

APPENDIX B
ATNAGE SUBROUTINES FOR PROCESSING AMSU-B DATA

A. REAL TIME PROCESSING

Many of these functions require the instrument unique Software to be ON. Functions not requiring unique software are marked (*).

1. Raw Data Prints and formatted (Galoppo) prints.

2. Status Checking:

   a. Prints out a status report on command
   b. Prints out when there is a digital function status bit change. (Operator may inhibit from the keyboard).

3. Scan Verification: The correct position of the antenna, when in Scan Normal Mode, is calculated. Errors are indicated when actual scan position does not agree with calculated position plus or minus tolerance.

4. Limit Checker: The Limit checker verifies that telemetry functions are within specified bounds. These bounds are established by data base and may be temporarily changed from the keyboard.

   *a. Analog Telemetry functions
   b. Digital A Housekeeping Telemetry functions

5. Radiance Monitor: Calculates and limit checks gains for 5 channels when in the Scan Normal Mode - using the internal target and external (space) target data. Calculates scene temperature for five radiometric channels and limit checks the differences between these values and the temperature of the external (space) target and internal calibration target temperatures. Also calculates and limit checks the standard deviation for the internal and external target data for each of the five channels.

6. *Command Verification: Telemetry (Digital B) status bits which are expected to change when commands are sent are verified by corresponders. The telemetry status to be verified is defined in a data base.

B. NON-REAL TIME PROCESSING (OFF-LINE)

1. Instrument Data Tape: This tape will contain AIP frame header information, TIP Digital B and Analog data, AIP and TIP parity, and AMSU-B data from AIP words 48-97.